JOURNAL

OF THE

ARNOLD ARBORETUM

HARVARD UNIVERSITY

EDITORIAL BOARD

A. C. SMITH, *Editor*
I. W. BAILEY
J. H. FAULL
I. M. JOHNSTON
C. E. KOBUSKI
P. C. MANGELSDORF
E. D. MERRILL
H. M. RAUP
A. REHDER
K. SAX

VOLUME XXII

JAMAICA PLAIN, MASS.
1941

Reprinted with the permission of the
Arnold Arboretum of Harvard University
KRAUS REPRINT CORPORATION
New York
1968

54680

DEC 12 1968

Greenhouse
Am
Ar 13
1968

DATES OF ISSUE

No. 1 (pp. 1–144, 5 pl.) issued January 15, 1941.
No. 2 (pp. 145–296, 9 pl.) issued April 17, 1941.
No. 3 (pp. 297–456, 11 pl.) issued July 15, 1941.
No. 4 (pp. 457–610, 4 pl.) issued October 15, 1941.

Printed in U.S.A.

TABLE OF CONTENTS

STUDIES IN THE LAURACEAE, III. SOME CRITICAL AND NEW SPECIES OF ASIATIC LINDERA, WITH OCCASIONAL NOTES ON LITSEA. By *Caroline K. Allen* 1

PLANTAE PAPUANAE ARCHBOLDIANAE, V. By *E. D. Merrill* and *L. M. Perry* 32

STUDIES OF PAPUASIAN PLANTS, I. By *A. C. Smith* 60

ADDITIONS TO OUR KNOWLEDGE OF THE FIGS OF NEW GUINEA. By *V. S. Summerhayes* 81

NEW PHANEROGAMS FROM MEXICO, IV. By *Ivan M. Johnston* 110

THE COMPARATIVE MORPHOLOGY OF THE ICACINACEAE. I. ANATOMY OF THE NODE AND INTERNODE. With four plates. By *I. W. Bailey* and *R. A. Howard* 125

A DISCUSSION OF NEW AND CRITICAL SYNONYMY. By *Leon Croizat*.. 133

A NEW GENUS OF FLACOURTIACEAE (PANGIEAE-HYDNOCARPINAE) FROM TROPICAL QUEENSLAND. With one plate. By *C. T. White* 143

GYPSOPHILY AMONG MEXICAN DESERT PLANTS. By *Ivan M. Johnston* 145

THE COMPARATIVE MORPOLOGY OF THE ICACINACEAE. II. VESSELS. With six plates. By *I. W. Bailey* and *R. A. Howard* 171

STUDIES IN THE THEACEAE, VI. THE GENUS SYMPLOCOCARPON AIRY-SHAW. By *Clarence E. Kobuski* 188

MOMORDICA GROSVENORI SP. NOV. THE SOURCE OF THE CHINESE LO HAN KUO. With two plates. By *Walter T. Swingle* 197

NEW SPECIES OF MALLOTUS. By *Franklin P. Metcalf* 204

RELCHELA PANICOIDES STEUDEL. GRAMINEAE ENDEMICA EN CHILE. Con una lamina. By *Carlos Muñoz* 209

CHROMOSOME BEHAVIOR IN CATALPA HYBRIDA SPAETH. By *E. Chalmers Smith* 219

A NOTE ON THE DATES OF PUBLICATION OF WIGHT'S "ICONES PLANTARUM INDIAE ORIENTALIS." By *E. D. Merrill* 222

LEDEBOUR'S "FLORA ROSSICA," "ICONES PLANTARUM NOVARUM," AND "FLORA ALTAICA," WITH A NOTE ON PALLAS' "FLORA ROSSICA." By *William T. Stearn* 225

STUDIES OF PAPUASIAN PLANTS, II. By *A. C. Smith* 231

PLANTAE PAPUANAE ARCHBOLDIANAE, VI. By *E. D. Merrill* and *L. M. Perry* 253

THE 1938–39 EXPEDITION TO THE SNOW MOUNTAINS, NETHERLANDS NEW GUINEA. With seven plates. By *L. J. Brass* 271

STUDIES OF PAPUASIAN PLANTS, III. By *A. C. Smith* 343

PLANTAE PAPUANAE ARCHBOLDIANAE, VII. By *E. D. Merrill* and *L. M. Perry* 375

BRASSIANTHA, A NEW GENUS OF HIPPOCRATEACEAE FROM NEW GUINEA. With one plate. By *A. C. Smith* and *I. W. Bailey* 389

STUDIES IN THE THEACEAE, VII. THE AMERICAN SPECIES OF THE GENUS CLEYERA. By *Clarence E. Kobuski* 395

THE TRIBE PLUKENETIINAE OF THE EUPHORBIACEAE IN EASTERN TROPICAL ASIA. By *Leon Croizat* 417

THE COMPARATIVE MORPHOLOGY OF THE ICACINACEAE. III. IMPERFORATE TRACHEARY ELEMENTS AND XYLEM PARENCHYMA. With three plates. By *I. W. Bailey* and *R. A. Howard* 432

SPECIES HYBRIDS IN FOREST TREES. By *E. Chalmers Smith* and *Charles Nichols, Jr.* 443

A NOTE ON THE DATES OF ISSUE OF THE FASCICLES COMPRISING COSSON'S "ILLUSTRATIONES FLORAE ATLANTICAE" 1882–1897. By *E. D. Merrill* 455

STUDIES IN THE THEACEAE, VIII. A SYNOPSIS OF THE GENUS FREZIERA. By *Clarence E. Kobuski* 457

STUDIES OF PAPUASIAN PLANTS, IV. By *A. C. Smith* 497

PLANTAE PAPUANAE ARCHBOLDIANAE, VIII. By *E. D. Merrill* and *L. M. Perry* 529

OBSERVATIONS ON OLD WORLD SPECIES OF TURPINIA VENTENAT. By *E. D. Merrill* and *L. M. Perry* 543

THE COMPARATIVE MORPHOLOGY OF THE ICACINACEAE IV. RAYS OF THE SECONDARY XYLEM. With four plates. By *I. W. Bailey* and *R. A. Howard* 556

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE COLLECTIONS OF THE ARNOLD ARBORETUM. By *Alfred Rehder* 569

A NEW WILLOW FROM FLORIDA. With one text-figure. By *William A. Murrill* and *Ernest J. Palmer* 580

THE ARNOLD ARBORETUM DURING THE FISCAL YEAR ENDED JUNE 30, 1941 582

BIBLIOGRAPHY OF THE PUBLISHED WRITINGS OF THE STAFF AND STUDENTS, JULY 1, 1940 — JUNE 30, 1941 594

STAFF OF THE ARNOLD ARBORETUM, 1940–1941 598

INDEX 599

JOURNAL

OF THE

ARNOLD ARBORETUM

VOL. XXII JANUARY, 1941 NUMBER 1

STUDIES IN THE LAURACEAE, III. SOME CRITICAL AND NEW SPECIES OF ASIATIC LINDERA, WITH OCCASIONAL NOTES ON LITSEA

CAROLINE K. ALLEN

THE SPECIES treated herein represent only those difficult of recognition in the herbarium. No attempt has been made to make a complete citation of literature, for this was done in 1932 by Liou.[1] Only supplementary and later publications have been noted where necessary. The *Litsea* species included are only incidental in clearing up certain species which have been confused with *Lindera*.

Lindera assamica (Meissn.) Kurz, For. Fl. Brit. Burma **2:** 308. 1877; Hooker f., Fl. Brit. Ind. **5:** 182. 1886; Liou, Laurac. Chine Indoch. 125. 1932.

Aperula assamica Meissn. in DC. Prodr. **15**[1]: 240. 1864, p.p.

DISTRIBUTION: India.

Lindera assamica, as well as *L. Meissneri,* has been reported from China. Liou even described a variety of the latter, var. *kwangtungensis* from the province of Kwangtung. Closely related is *Lindera annamensis* Liou from French Indo-China. *Lindera assamica,* as interpreted by King, according to Hooker f., l.c., is based on *Jenkins 1171,* from Bhotan, and has large elliptic or lanceolate-elliptic membranaceous leaves up to 15 cm. long, with prominent reticulation on the upper surface. The inflorescences are numerous on slender peduncles, the branchlets as well as the leaves beneath are rusty- or tawny-hirsute and pubescent (fide Hooker f., l.c.). *Jenkins 124* (Hooker states that this number is erroneously credited to Jenkins), the second specimen on which Meissner based *Aperula assamica,* is not the latter but *L. Meissneri* King

[1]Liou, Ho, Lauracées de Chine et d'Indochine. Paris, 1932.

in Hook. f. The material from China does not belong in this species. It has leaves which are far more coriaceous, and inflorescences which are borne on stouter peduncles. There is not the fragile, delicate appearance in the Chinese specimens that one notes at once in the Indian.

Lindera Meissneri King in Hooker f., Fl. Brit. Ind. **5**: 182. 1886; Liou, Laurac. Chine Indoch. 126. 1932.

Aperula assamica Meissner in DC. Prodr. **15**[1]: 240. 1864, p.p.

DISTRIBUTION: India.

The leaves of the above are never more than 9 cm. long, and are caudate-acuminate, dark, glabrous, shining above, and borne on more slender petioles than those of *Lindera assamica*. The inflorescences are smaller and the branchlets are smooth. Again, the Chinese material is no match for the species, for the same reason that it must be kept apart from *L. assamica,* i.e., the specimens are heavier and coarser.

Lindera Meissneri King f. **lenticellata** Liou, Laurac. Chine Indoch. 126. 1932.

DISTRIBUTION: French Indo-China.

Liou described this variety from Tonkin as differing from the type in having its branchlets covered with lenticels, and its leaf-blades smaller and finely long-acuminate. With the types of both the species and variety at hand, the differences appear to be the numerous lenticels present on the branchlets of the variety, the more coriaceous leaves, the upper surface of which is opaque as opposed to the shining upper surface of the leaves of the species. The size of the leaves as well as their caudate-acuminate tips scarcely varies between the species and the variety. Many specimens from Yunnan have the lenticels but the leaves are shining above and not as dark as those of Liou's variety. These former will be taken up later. The type of the following species (Liou's var. *kwangtungensis*) has lenticels on the branchlets, though not as plentifully as in the variety *lenticellata*.

Lindera kwangtungensis (Liou), comb. nov.

Lindera Meissneri King f. *kwangtungensis* Liou, Laurac. Chine Indoch. 126. 1932.

Arbor 6–20 m. alta, ramulis teretibus, junioribus angulatis striatis lenticellatis minute pubescentibus. Folia alterna, lanceolata vel lanceolato-elliptica, subcoriacea, 5–10 cm. longa et 1.5–3 cm. lata, obtusa, acuta vel acuminata, ad basim acuta, utrinque glabra, conspicue reticulata, supra opaca, subtus glaucissima, penninervia, nervis 4–8-jugis, utrinque plerumque inconspicuis, costa subtus conspicue elevata, fusca,

petiolo 7–10 mm. longo, glabro. Inflorescentiae ♂ umbellae numerosae ad apicem ramulorum aggregatae, sessiles brevi-pedunculataeve, axillares vel in ramulis brevibus subterminales, pedunculatae, pedunculis, 12–20 mm. longis gracilibus adpresse pubescentibus. Flores 4–9, ± 3 mm. longi, pedicellis tenuibus 5–6 mm. longis adpresse pubescentibus, lobis 6 sparse pubescentibus ellipticis, staminibus 9, 3 interioribus bi-glandulosis. Fructus subglobosus, 5–6 mm. diam., apiculatus, glaber, viridi-nigrescens, disco 2–3 mm. lato, pedicello 4–6 mm. longo crasso rugoso.

DISTRIBUTION: southeastern China (Kwangtung, Hainan, Kwangsi).

KWANGTUNG: *S. P. Ko 50170* (TYPE of *L. Meissneri kwangtungensis*, ♂, NY). HAINAN: *F. C. How 73449; H. Y. Liang 63521, 64753; N. K. Chung & C. L. Tso 44341.* KWANGSI: *C. Wang 40694; W. T. Tsang 24307* (possibly).

This variety seems worthy of specific rank, since the differences are more than the smaller leaves and the nerves less salient below, which Liou gives as the distinguishing characters. The leaves are more coriaceous than those of the species, their reticulation more conspicuous, the under surface more glaucous, the upper surface opaque instead of shining, and the inflorescence longer and less slender than in the species. There seem to be no short shoots bearing inflorescences as is typical in the variety and the branchlets of the latter are somewhat lenticellate.

Lindera kwangtungensis (Liou) Allen f. **robusta,** f. nov.

A typo differt foliis majoribus, late ellipticis, abruptius acuminatis, ad basim attenuatis, petiolis ad 2 cm. longis, crassis.

DISTRIBUTION: southeastern China (Hainan).

HAINAN: Chim Fung Mt., near Sha Mo Kwat Village Kan-en District, *S. K. Lau 5083* (TYPE ♂, AA), fairly common, height 14 m., diam. 27 cm., flower yellow; *N. K. Chun & C. L. Tso 44340,* pp. (fruit, AA), *43871, 44101, 44170, 44329; H. Y. Liang 63379, 64528; L. Tang 444; C. Wang 35922.*

The form differs from the species in having leaves up to 12 cm. long and broadly elliptic, more abruptly acuminate, and more attenuate at the base, with stouter petioles up to 2 cm. long. The flowers of the ♀ inflorescence are very densely pubescent. The original sheet labeled *Chun & Tso 44340* consisted of two entities — *Lindera kwangtungensis* and a species of *Linociera.*

Lindera Metcalfiana, spec. nov.

Arbor vel frutex 3–12 m. altus, ramulis teretibus, junioribus plus

minusve angulatis striatis rubro-brunnescentibus glabris. Folia alterna, elliptica, membranacea, 9–14 cm. longa et 3–4 cm. lata, acuminatissima caudatave, saepe falcata, ad basim acuta, glabra, utrinque reticulata, opaca, supra viridiscentia, subtus plus minusve glauca, penninervia, nervis 8–10-jugis, supra impressis, subtus elevatis, rubescentibus, petiolo 10–12 mm. longo, glabro. Umbellae ♂ paucae vel solitariae, axillares, pedunculatae, bracteis glabris deciduis, pedunculis 7–15 mm. longis tenuibus glabrescentibus. Flores 5–10, pubescentes, virides (fide collectoris), pedicellis 3–5 mm. longis minute pubescentibus, lobis 6 oblongo-ovatis sparse pubescentibus, staminibus 9, 3 interioribus bi-glandulosis. Fructus globosus ± 6 mm. diam., nigrescens, disco parvo pubescente 3–4 mm. lato leviter dentato ciliato, pedicello ± 6 mm. longo, crasso. Umbellae ♀ ignotae.

DISTRIBUTION: southeastern China. (Hainan, Kwangtung, Kwangsi).

HAINAN: *C. Wang 36163* (TYPE, AA), January 6, 1934, tree 12 m. high, diam. ½ m., in mixed woods, fl. green, *35720, 36156; H. Y. Liang 63464; S. K. Lau 5216; N. K. Chun & C. L. Tso 44044.* KWANGTUNG: *Wang & Ling* for *W. Y. Chun 7405, 7376; Y. Tsiang 798; C. C. C.* (under direction of Levine) *3087.* KWANGSI: *R. C. Ching 8198; S. K. Lau 28746.*

The species belongs in the group with the preceding species, but is distinct from them. It has the membranaceous leaves (which appear rather thicker in the fruiting specimen, as is to be expected), with reticulations similar to but not as distinct as those of *L. Meissneri.* Nor are the leaves shining above, nor quite as glaucous below, and they are more caudate than those of the latter. *Wang & Ling 7376* and *C. C. C. 3087,* from Kwangtung, have leaves approaching a coriaceous texture and more prominently reticulate than the specimens cited above. In this respect, they suggest the succeeding species from western China, though for the present they will be left as *L. Metcalfiana,* presumably their nearest relative.

The following numbers collected by H. T. Tsai in Yunnan are probably specimens of very young flowers. The buds are advanced enough to show the anthers with the unmistakable two locules. The affinity is with *L. Metcalfiana* from Kwangtung and Hainan, though there are a few differences noted. The branchlets and veins are less reddish in the Yunnan material. The leaves are shorter, usually, and broader, and in some instances the glaucescence of the underleaf surface is not as apparent as in the Hainan specimens. The individuals from Yunnan are in too young a state to enable satisfactory dissection which might produce further differentiating characters, so for the time being they

will be included with *L. Metcalfiana*. YUNNAN: *H. T. Tsai 51556, 51634, 51674, 51683.*

The above is named for Dr. Franklin P. Metcalf, Curator of the Herbarium of Lingnan University and a keen student of the flora of southeastern China.

Lindera dictyophylla, spec. nov.

Arbor 2.5–9 mm. alta, ramulis teretibus, junioribus plerumque angulatis striatis, rubro-brunnescentibus glabrescentibus. Folia alterna, lanceolata, 8–13 cm. longa et 2.5–3.5–(4) cm. lata, coriacea, attenuate acuta vel acuminata, basi acuta, glabra, utrinque crasse reticulata, supra plus minusve nitida, viridiscentia, subtus glauca, penninervia, nervis 5–8-jugis supra impressis subtus elevatis brunnescentibus, petiolo 6–12 mm. longo pubescente vel glabrescente. Inflorescentiae ♂ sessiles vel brevipedunculatae. Umbellae usque 5, axillares, pedunculatae, bracteis deciduis, pedunculis 5–7 mm. longis paullo crassis pubescentibus. Flores 10–12, pubescentes, flavo-albi (fide collectoris), brevi-pedicellati, lobis 6 oblongis utrinque pubescentibus, staminibus 9 leviter exsertis, 3 interioribus bi-glandulosis. Umbellae ♀ 2–4, axillares, pedunculatae, bracteis deciduis, pedunculis 5–6 mm. longis paullo crassis, pubescentibus. Flores 10–12, pubescentes, viridi-albi (fide collectoris), brevi-pedicellati, lobis 6 ovatis, staminodiis 9, 3 interioribus bi-glandulosis. Fructus globosus, ± 6 mm. diam., viridescenti-purpurascens (fide collectoris), disco parvo pubescente 3–4 mm. lato leviter dentato-ciliato, pedicello ± 5 mm. longo crasso pubescente.

DISTRIBUTION: western China (Yunnan).

YUNNAN: Shun-Ning Hsien, *C. W. Wang 71835* (TYPE ♂, AA), mountain slope, February 1936, alt. 2800 m., flower yellowish-white; *C. W. Wang 71992,* same locality and date, alt. 2700 m., flower greenish-white (♀, AA); Fo-Hai, *C. W. Wang 77395,* alt. 2000 m., fruit green to purple, aromatic (AA); *C. W. Wang 74186, 76276, 78273; H. T. Tsai 51924; G. Forrest 9562, 9674, 26204, 26212.*

Forrest 26212 has more uniformly larger leaves than most of the Wang numbers. In number 9674 the leaves are more elliptic than lanceolate. In number 26204 the tendency is toward a more leafy branch with the leaves smaller and distinctly elliptic. Number 9562 is also more leafy with smaller leaves, ovate rather than lanceolate. These data are noted here to indicate the extreme variability of the species.

The following specimens are very leafy. The mature leaves are shining, dark brown above and paler below, varying in size and shape on the same branch, lanceolate to elliptic. The very young leaves and

branchlets are clothed in golden brown, closely appressed pubescence which is early deciduous. The color of the leaves in the entire Tsai collection means nothing, for it is apparent that the specimens were dried artificially and burned in the process, in some cases very severely. YUNNAN: *H. T. Tsai 56351, 56760, 56794, 56801, 56809, 56869, 56876, 56877.*

In this complex from Yunnan, there appear to be about three entities, where the leaves are coriaceous, mostly shining above and extremely reticulate, usually glaucous below. There is a great temptation to describe three separate species, because of the fact that the groups of specimens seem to be so very different. Close study reveals the impossibility of separating any of them on good characters that do not vary. Such characters as leaves shining above, and glaucous below, for example, altitude, season of collection, and conditions of drying the specimens undoubtedly play an important part in modifying these characters. Since in this group glaucescence is determined apparently by the state of the minute exudations from each cell of the lower leaf epidermis, it is easy to understand that the natural appearance of the leaf might be changed easily by any one of the factors mentioned above.

The following numbers mostly from Yunnan, show smaller leaves, more variable in size than those cited under the species. There seems to be a trend toward more numerous inflorescences per branch, the upper surface more or less shining, the under glaucous. YUNNAN: *A. Henry 12822, 12822 A,B,C, 13285; G. Forrest 9525; H. T. Tsai 51557; C. W. Wang 78378.* KWANGSI: *A. N. Steward & H. C. Cheo 133.*

Lindera longipedunculata, spec. nov.

Frutex 3–6 m. altus, ramulis teretibus, junioribus angulatis striatis rubescentibus vel brunnescentibus glabris. Folia alterna, elliptica, subcoriacea, 8–15 cm. longa, et 3–5 cm. lata, acuta vel abrupte acuminata, glabra, utrinque crasse reticulata, supra opaca, viridi-brunnescentia, subtus glauca, penninervia, nervis 8–10-jugis supra leviter subtus conspicue elevatis brunnescentibus, costa supra plerumque impressa, petiolo 10–12–(15) mm. longo glabro. Inflorescentiae ♂ sessiles vel brevipedunculatae. Umbellae plerumque solitariae, pedunculatae, bracteis deciduis glabris, pedunculis 2–2.5 cm. longis tenuibus gracillimis saepe curvatis glabris. Flores 6–8–(12?) pallide flavescenti-virides (fide collectoris), pubescentes, lobis 6 oblongis utrinque pubescentibus, staminibus 9–10, 5–6 bi-glandulosis. Fructus globosus, ± 5–6 mm. diam., nigrescens, immaturus viridis (fide collectoris), disco parvo glabrescente, 3–4 mm. lato leviter dentato ciliato, pedicello ± 1 cm. longo leviter crasso.

DISTRIBUTION: western China (Yunnan).

YUNNAN: Taron-Taru Divide, Tehgai, *T. T. Yü 20986* (TYPE ♂, AA), November 5, 1938, evergreen shrub 10 ft., common among mixed forest, alt. 2300 m. ♂, fl. pale yellowish green; Lungnan, same locality, *T. T. Yü 20014,* August 28, 1938 (fruit & ♀ fl., AA); *T. T. Yü 20876, 20986; G. Forrest 16065, 16104, 17528.*

This species is set apart from the preceding species of the group by its loosely reticulate, opaque, elliptic, abruptly acuminate leaves, always glaucous below; and by its striking inflorescence with long, slender, graceful peduncles, often curving beneath the weight of the large, full-flowered umbels at their tips.

Lindera latifolia Hooker f., Fl. Brit. Ind. **5:** 183. 1886; Liou, Laurac. Chin. Indoch. 125. 1932.

DISTRIBUTION: India and western China (Yunnan).

INDIA. E. Bengal: Griffith (Kew Distrib. No. 4321) (TYPE, Kew; isotype, Gray).

CHINA. Yunnan: *C. W. Wang 67011, 72101, 72527; A. Henry 13269; G. Forrest 9613, 9633, 15846, 17541, 17688; T. T. Yü 17252; H. T. Tsai 54331, 54407, 56368, 56392, 56866, 56892, 58903.*

Of the species of this particular group there is only one of which material is plentiful and that is the above species, described from India. Outside of India, thus far, it is to be found in the province of Yunnan only. There is variation to be seen in the Yunnan plants but there is no doubt that they represent the Chinese form of Hooker's species. The latter is distinct, because of the broad leaves which are greyish glaucous below, with the veins covered with an almost ferrugineous pubescence. *Lindera Balansae* from Tonkin, has this same distinctive lower-leaf surface, but can be separated readily by the much more narrow lanceolate to oblong-lanceolate leaves, as opposed to the broadly obovate or elliptic leaves of *L. latifolia. Lindera racemosa,* also from Tonkin, and very close to *L. Balansae,* according to the description and the photo of the type available, is distinguished by lack of pubescence on the lower leaf surface and by the presence of numerous umbels from a common peduncle, instead of the solitary, or at most, 2 umbels found in *L. Balansae.*

The Tsai specimens from Yunnan lack, for the most part, the characteristic grey-glaucous lower leaf surface, though the usually attending pubescence is even more dense than in the type. Except for this feature, the specimens do not vary enough to warrant a new variety. As has been mentioned before, the Tsai material seems to have been badly

burned, so any variation in leaf texture may be expected of the specimens.

Lindera glauca (S. & Z.) Blume, Mus. Bot. Lugd.-Bat. **1**: 325. 1851; Liou, Laurac. Chine Indoch. 129. 1932.

Benzoin glaucum S. & Z. in Abh. Akad. Muench. **4**[3]: 205. (Fl. Jap. Fam. Nat.) 1846; Nakai, Fl. Sylv. Kor. **22**: 80, t. 14. 1939.

For complete synonymy, see Liou, l.c.

DISTRIBUTION: Japan and China.

Nakai l.c. has made a var. *glabellum* of the above species as follows: "Folia adulta infra secus costas et margine infra medium pilosella, cetera glaberrima." No specimens of the variety are available, but variation or density of pubescence do not seem strong enough characteristics on which to set up a variety. Examination of type material may show sufficient differences, not mentioned in the description.

Lindera angustifolia Cheng in Contr. Biol. Lab. Sci. Soc. China **8**: 294, fig. 21. 1933.

Benzoin sinoglaucum Nakai, Fl. Sylv. Kor. **22**: 79. 1939.

DISTRIBUTION: eastern China (Chekiang, Kiangsi, Kiangsu, Hupeh and Kwangtung).

CHEKIANG: *S. Chen 1028* (TYPE ♀ fl. of *B. sinoglaucum*, Tokyo; isotype, AA); *2554; R. C. Ching 4814; F. N. Meyer 230.* KIANGSI: *F. B. Forbes 1417* (probably other Chinese specimen without number cited by Nakai, l.c. under *B. sinoglaucum*); *A. N. Steward 2734; Y. L. Keng 1519; E. H. Wilson 1634.* KIANGSU: *Y. L. Keng 2387; C. L. Tso 1737* (cited with original description of *L. angustifolia*), *819, 889, 1209, 1432, 1678; R. C. Ching & C. L. Tso 466, 502, 552, 674, 696, 702, 709, 724; J. Hers 2313.* HUPEH: *H. H. Chung 9067; S. C. Sun 24.* KWANGTUNG: *F. A. McClure 353 (102, 2721); C. L. Tso 20262.*

A species which is similar to *Lindera glauca* in texture and leaf surface yet differs in the leaf shape which is lanceolate or oblong-lanceolate, as opposed to the obovate-elliptic leaves of *L. glauca*. *Chen 1028* (type of ♀ flowers) and *Forbes 1417*, cited by Nakai with the description of his new segregate from *Lindera angustifolia* do not appear to vary sufficiently from the latter to warrant specific or even varietal delimitation.

Lindera communis Hemsl. in Jour. Linn. Soc. Bot. **26**: 387. 1891; Liou, Laurac. Chine Indoch. 130. 1932.

Benzoin commune (Hemsl.) Rehder in Jour. Arnold Arb. **1**: 144. 1919.
Lindera yunnanensis Léveillé in Fedde, Rep. Spec. Nov. **10**: 371. 1912.
Lindera Bodinieri Léveillé, l.c.

Lindera Paxiana H. Winkler in Limpricht, Bot. Reis. Hochgeb. Chin. 382. 1922.
Lindera glauca Blume var. *nitidula* Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris, sér. v, **5**: 115. 1913.
Beilschmiedia parvifolia Lecomte, l.c. 110.

DISTRIBUTION: China and French Indo-China.

Lindera communis has leaves lanceolate-acuminate, 5–9 cm. long, which vary considerably in leaf surface. The upper surface may be shining and smooth, or dull and minutely reticulate, while the lower may be glabrescent to densely pubescent. The pubescence of the branchlets is variable also. The species is wide-spread throughout China.

In the same group with *Lindera communis* Hemsl., described from central China are found *Lindera nacusua* (D. Don) Merr. (erstwhile *L. bifaria* Benth.) and *L. Laureola* Coll. & Hemsl., from India.

Lindera communis Hemsl. var. **grandifolia** Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris, sér. v, **5**: 118. 1913; Liou, Laurac. Chine Indoch. 131. 1932.

DISTRIBUTION: French Indo-China.

Lecomte's variety, of which only a photo is available, seems to be fairly true to the type of the species except for the larger leaves.

Lindera Laureola Collet & Hemsley in Jour. Linn. Soc. Bot. **28**: 119. 1890; Liou, Laurac. Chine Indoch. 130. 1932.

Benzoin Laureolum (Coll. & Hemsl.) Chun in Contr. Biol. Lab. Sci. Soc. China. 1^5: 45. 1925.

DISTRIBUTION: Burma.

In leaf shape, size and habit, generally, the above recalls *L. communis*. The leaves are more elliptic-lanceolate than lanceolate and there is a complete lack of pubescence except on the inflorescence. The bracts are glabrescent, the corolla sparingly pubescent and the pedicels densely so.

Lindera Nacusua (D. Don) Merrill in Lingnan Sci. Jour. **15**: 419. 1936.

Laurus Nacusua D. Don, Prodr. Fl. Nepal. 64. 1825.
Tetranthera bifaria Wallich, List. No. 2530. 1830, nomen nudum.

For complete synonymy, see Merrill, l.c.

DISTRIBUTION: southeastern Asia.

INDIA: Nepal, *Wallich No. 2530*, pp. (ISOTYPE of *Tetranthera bifaria* Kew, NY).

FRENCH INDO-CHINA. Annam: *E. Poilane 24655.*

CHINA. Yunnan: *C. W. Wang 80470; T. T. Yü 19457.* Szechuan: *Y. Liu 1639, 1784.*

Lindera Nacusua as based on *Laurus Nacusua* D. Don was described according to Don from a specimen of Hamilton from Nepal. Nees described *Daphnidium bifarium* based on *Tetranthera bifaria* Wallich No. 2530, also from Nepal, from Wallich's collection of 1821, and Blinkworth's specimen from Kamaon. The leaves of the specimens at hand from the Wallich Herbarium vary from 5–15 cm. in length, are lanceolate to broadly lanceolate, acuminate, with short appressed pubescence on the lower surface. All have in common somewhat elevated reticulation on the undersurface of the leaves. The young branchlets are densely tomentose. Hooker f. (Fl. Brit. Ind. **5**: 184. 1886) included *Laurus Nacusua* as a synonym of *L. bifaria.* The Griffith specimens which he cites have broadly lanceolate to elliptic leaves somewhat acuminate to acute, with extremely prominent reticulation below, the veins densely villous as opposed to the not too prominent reticulation and dense, short-appressed pubescence of the leaves of *L. Nacusua.* Possibly the following numbers belong with this species. KWANGTUNG: *W. T. Tsang 28511.* HAINAN: *S. K. Lau 5263; F. C. How 72808, 73304.*

Lindera Doniana, spec. nov.

Arbor parva (?), ramulis crassiusculis rugulosis griseo-brunnescentibus glabris, junioribus ferrugineo-tomentosis. Folia alterna, late lanceolata vel elliptica, subcoriacea, 5–7 cm. longa et 2–2.5–(3) cm. lata, acuminata, acuta vel saepe subrotundata, vel leviter emarginata, basi cuneata, supra initio glabrescentia demum glabra, saepe nitida, subtus pallida, crebre ac conspicue reticulata, penninervia, nervis 7–10-jugis supra valde impressis subtus bene elevatis dense villosis, petiolo 5–8 mm. longo crasso pubescente. Umbellae ♂ sessiles, 1–3, brevi-pedunculata, bracteis plus minusve persistentibus, extus ad medium adpresse pubescentibus. Flores 6–8, lobis 6 (?), (post anthesin tantum visa). Fructus subglobosus ± 6 mm. diam., nigrescens, cupula pubescente planiuscula ± 3 mm. lata, pedicello 3.5 mm. longo pubescente crasso.

DISTRIBUTION: India and China (Yunnan).

INDIA. Bengal: *Griffith* (Kew Distrib. No. *4314*) (TYPE, Kew; isotype AA); Khasia: *J. D. Hooker & T. Thomson,* regio trop. 3–4000 ped. (as *Daphnidium bifarium* Nees var.?) (G).

CHINA: Yunnan: *T. T. Yü 20015.*

These specimens, because of their distinctive venation, recall the Japanese species, *Litsea acutivena* Hayata. The *Litsea* species, however,

have definitely cano-sericeous bracts which are even more persistent than those of *Lindera Doniana*. And while in the latter species there is a tendency toward rounded leaf tips, in the former it is the usual case.

Litsea Merrilliana, spec. nov.

Arbor parva vel frutex ad 2 m. altus, ramulis teretibus striatis, junioribus rubescentibus maturis griseis glabris. Folia alterna, oblongo-lanceolata, saepe lanceolata vel elliptica, subcoriacea, 2–7 cm. longa et 1.5–3 cm. lata, acuta vel acuminata, basi obtusa subrotundatave, utrinque glabra, supra minute alveolata, viridia, subtus pallida vel glauca, pennivervia, nervis 8–12-jugis flavis, costa utrinque elevata, petiolo 5–10 mm. longo glabrescente. Umbellae ♂ solitariae, axillares, pedunculatae, numerosae, pedunculis gracilibus ad 5 mm. longis pubescentibus, bracteis pallidis adpresse ferrugineo-pubescentibus. Flores pauci, immaturi, pallide virides (fide collectoris) lobis 6 (?), staminibus 7 (?), filamentis pubescentibus. Umbellae ♀ paucae, axillares, pedunculatae, pedunculis 5–6 mm. longis gracillimis glabrescentibus, bracteis adpresse-pubescentibus deciduis. Flores ± 5, virides (fide collectoris), brevi-pedicellati. Fructus oblongus ± 6 mm. longus viridis (fide collectoris), disco 2.5 mm. lato, pedicello ± 2 mm. longo crasso planiusculo subconcavo.

DISTRIBUTION: southern China. (Kwangsi, Kweichow).

KWANGSI: Tzu Yuen District, *T. S. Tsoong* (*Z. S. Chung*) *83503* (TYPE ♂, AA), August 4, 1937, small tree in woods, leaves deep green above, pale green beneath, flower pale green; *T. S. Tsoong 83456; C. Wang 39562* (very young ♀ flower and old fruit). KWEICHOW: Fan Ching Shan *A. N. Steward, C. Y. Chiao & H. C. Cheo 521* (inflorescence in very young fruit).

A species similar to *L. communis* in variation of leaf size and shape, but differing in having more pairs of nerves which are more slender and more nearly at right angles to the mid-rib, a glabrous leaf and veins which stand out yellowish against the green of the leaf. The pistillate inflorescence has very slender peduncles and short pedicelled flowers.

The species is named for Dr. E. D. Merrill, Director of the Arnold Arboretum, whose assistance is indispensable in the preparation of any manuscript dealing with Asiatic plants.

Lindera pedunculata Diels in Bot. Jahrb. **29:** 350. 1901.

Benzoin pedunculatum (Diels) Rehder in Jour. Arnold Arb. **1:** 145. 1919.

DISTRIBUTION: western China (Szechuan, Yunnan).

SZECHUAN: *W. P. Fang 896* (fruit, AA), *844*. YUNNAN: *T. T. Yü 20154*.

Fructus oblongus, ± 9 mm. longus, ± 6 mm. latus, nigrescens, cupula ± 2 mm. longa pubescente ± 5 mm. lata, pedicello ± 6 mm. longo pubescente crassiusculo.

Here also may be placed for the present *Fang 1281*, from Kikiang Hsien, differing in the shorter, thicker, pedunculate umbels and less oblong, more round fruit. It may be a variety, possibly. *Poilane 24561* from Annam has leaves that are heavier, more reticulate and more densely pubescent and the branchlets are stouter. The pedicels are similar to those of *Fang 1281*.

The species has not been taken up, as far as can be ascertained from the literature, since its description, except for the transfer to *Benzoin* in 1919. Its affinity, as Diels suggests, seems to be *Lindera communis*, but it stands apart from that species because of the oblanceolate leaves more or less rounded at the base, and the oblong fruit. No staminate inflorescence has been seen as yet, the type description having been made from a pistillate branch. Just possibly the plant belongs in another genus, *Litsea* for example.

Lindera Duclouxii Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris, sér. v, **5**: 113. 1913; Liou, Laurac. Chine Indoch. 128. 1932.

Lindera spec. ? in Not. Bot. Gard. Edinb. **14**: (Pl. Chin. Forrest. Edinb.) 276. 1924.

DISTRIBUTION: western China (Yunnan, Tibet).

This is a little known species from Yunnan and Tibet. It is perhaps more closely allied to *L. Nacusua* than to any other species, but differs in having broader leaves usually rounded at the base and frequently unequal. The tip is more abruptly acuminate and the flowers larger, borne on longer pedicels.

Lindera sterrophylla, spec. nov.

Arbor parva vel frutex 2.5–5 m. altus, ramulis teretibus striatis rubescentibus, glabrescentibus demum glabris. Folia alterna, elliptica vel oblongo-elliptica, robusta, coriacea, 10–13 cm. longa et 4–5 cm. lata, acuminata vel abrupte obtuse acuminata, basi acuta, utrinque glabra, supra viridia plus minusve nitida, subtus glauca (fide collectoris), penninervia, nervis 6–8-jugis utrinque glabris, costa supra glabra basi ad 5 mm. longitudinem pubescente excepta, supra impressis (costa leviter elevata excepta), subtus conspicue elevatis, petiolo 1–1.5 mm. longo canaliculato glabro praeter canaliculum. Umbellae ♂ solitariae, axillares, brevipedunculatae, bracteis deciduis. Flores 3-6, pubescentes, viridescentiflavi (fide collectoris), pedicellis 3–8 mm. longis minute fulvo-pubescentibus, lobis 6 oblongis, staminibus 9, 3 interioribus bi-glandulosis. Umbellae

♀ paucae similes ♂. Flores parvi ± 2 mm. longi, viridescenti-albi (fide collectoris), pedicellis 1–2 mm. longis pubescentibus, lobis 6 oblongo-ovatis, staminodiis 9, 3 interioribus bi-glandulosis. Fructus obovoideus, 10–12 mm. longus, ± 9 mm. diam., cupula pubescente corrugata ± 3 mm. longa et 3–4 mm. lata, pedicello, 2–6 mm. longo pubescente crasso, pedunculo communi ± 3 mm. longo.

DISTRIBUTION: western China (Szechuan).

SZECHUAN: Under woods, Mt. Omei *T. T. Yü 392* (TYPE ♂, AA), April 18, 1932, alt. 1600 m., small tree 2.5 m. high, leaves dark green above, whitish beneath, flower greenish yellow; Mt. Omei *T. T. Yü 404,* April 18, 1932, alt. 1500 m., shrub among woods, leaves dark green above, bluish beneath, flower greenish white (♀, AA); *Yü 188, 393, 396, 416; W. P. Fang 2468,* Mt. Omei, August 4, 1928, alt. 1050–1220 m., shrub 5 m. in thickets, fruit obovate, drupaceous (AA); *W. P. Fang 23238, 23596.*

A species distinct because of the leathery leaves, glabrous and shining above, slightly revolute at the margins. The leaves of the type are broader and more abruptly acuminate at the apex than are those of the other specimens cited but undoubtedly the same. The very small pistillate flowers form a smaller umbel, which is sessile, than those of the staminate inflorescence. The species is similar to *Lindera Duclouxii* from Yunnan and Tibet, but is distinguished at once by its almost complete glabrity.

Lindera umbellata Thunberg, Fl. Jap. 145. t. 21, 1784.

Benzoin umbellatum Rehder in Jour. Arnold Arb. **1**: 146. 1919.
Lindera membranacea Maxim. in Bull. Acad. Sci. St. Petersb. **12**: 72. 1867, in Mél. Biol. **6**: 275. 1868.
For further synonymy, see Rehder, l.c.

DISTRIBUTION: Japan.

JAPAN: *Thunberg* (TYPE of *L. umbellata,* Upsala; photo & fragm. AA); *Tschonoski* (*Maximowicz,* iter secundum) (TYPE of *L. membranacea,* fruit, Leningrad; isotype AA); *Herb. K. Shiota,* No. *41, 48, 6421.* Unfortunately the other collections in the AA Herb. are unnumbered, among which are numerous sheets collected by E. H. Wilson and C. S. Sargent.

The "umbellata" complex might very aptly be termed unfinished business, for a number of reasons. First, some of the species have been described from immature plants or plants with precocious flowers. Second, it is necessary in this group to keep in close touch with Japanese herbaria, for without authentically annotated specimens it is at times

impossible to understand the Japanese authors' concept of species — one of their native species as wide-spread as *L. umbellata,* for example.

The great difficulty in ascertaining the specific limitations of *Lindera umbellata,* as well as *L. Thunbergii* (now segregated as *L. erythrocarpa*), lies in the fact that both of these species were based on specimens in immature stages. One may guess that leaves will at maturity have lost their early pubescence, but it goes without saying that the remaining pubescence, if any, may vary in many ways. The bark of the young specimens of each species is very different. That of *L. umbellata* is smooth, shining, reddish, while that of *L. Thunbergii* (*L. erythrocarpa*) is more rough and is pale grey. The mature specimens could never be confused. *Lindera erythrocarpa* has leaves very long-attenuate at the base, lanceolate-obovate, reddish brown in color, paler on the lower surface and with rough pubescence. The fruit, according to Makino (Tokyo Bot. Mag. **13:** 140. 1899) is scarlet. *Lindera umbellata* has leaves which are less long-attenuate at the base, are broader and usually not reddish, and very sparsely pubescent if at all, on the lower surface. The fruit (see Makino, l.c.) is black. Makino, in 1900, was correct in separating the two entities, giving *L. Thunbergii* the new name *L. erythrocarpa.* (See Makino, l.c., Rehder, l.c.) In 1846, Siebold and Zuccarini described *Benzoin sericeum* with leaves pubescent above and softly villous below, and with new parts white-sericeous, with branchlets blackish fuscous or black, and fruits globose, mucronulate. Blume in 1851, transferred the species to *Lindera* adding a β var. *glabrata* with lanceolate-oblong leaves everywhere glabrous. Makino (1900), made the species a variety of *L. umbellata,* but on careful consideration it appears now to be worthy of specific rank.

At the time of Maximowicz' description of *Lindera membranacea,* he had at hand undoubtedly, the currently known species of *L. umbellata* with which to compare his new species. Hence, his comparison of the broader leaves of *L. membranacea,* with those of *L. umbellata* (probably now Makino's segregate *L. erythrocarpa*), the longer, more slender peduncles and pedicels as opposed to the shorter and thicker peduncles and pedicels of *L. umbellata.* So, it appears from careful examination of the types that the species which Maximowicz describes as new is merely the old *L. umbellata,* and the *Lindera umbellata* to which he compares it the species now known as *L. erythrocarpa.* Thus *L. membranacea* is probably correctly reduced to synonymy under *L. umbellata.*

Lindera umbellata var. **hypoglauca** (Maxim.) Makino in Tokyo Bot. Mag. **14:** 185. 1900.

Lindera hypoglauca Maxim. in Bull. Acad. Sci. St. Petersb. **12**: 71. 1867, in Mél. Biol. **6**: 274. 1868.

Benzoin hypoleucum O. Kuntze, Rev. Gen. **1**: 569. 1891.

Benzoin hypoglaucum (Maxim.) Rehder in Bailey, Cycl. Am. Hort. **1**: 153. 1900.

Benzoin umbellatum var. *hypoglaucum* Rehder in Jour. Arnold Arb. **1**: 146. 1919.

DISTRIBUTION: Japan, and cultivated.

Under this variety the annotated specimens which are available from Japan show a leaf which is much smaller (not more than 7 cm.), usually obtuse or acute, very coarsely reticulate, unmistakably glaucous below, and rather papery in texture. The remainder of the material from Japan was named in America, consists mostly of Wilson's specimens and is indistinguishable from the specimens of *L. umbellata* proper from Japan.

Lindera umbellata var. **pubescens** Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris. sér. v, **5**: 113. 1913; Liou, Laurac. Chine Indoch. 129. 1932.

DISTRIBUTION: western China (Yunnan).

YUNNAN: *J. M. Delavay 4296* (TYPE of *L. umbellata* var. *pubescens*, Paris; photo & fragm. AA).

So far only the type of Lecomte's variety has come to light. It is, unfortunately, a branch in fairly young fruiting stage with leaves seemingly not fully developed. The whole aspect of the plant is suspiciously like that of a *Litsea* in general and of *Litsea sericea* in particular. There are differences which separate it from *Litsea sericea* but it might easily be one of the many species of that genus described from young flowers only.

Lindera erythrocarpa Makino in Tokyo Bot. Mag. **11**: 219. 1897, **13**: 138. 1899.

Benzoin erythrocarpum Rehder in Jour. Arnold Arb. **1**: 144. 1919.

For complete synonymy, see Rehder, l.c.

DISTRIBUTION: Japan, Formosa, Korea, and China.

JAPAN: (TYPE, *Benzoin Thunbergii* S. & Z., Leningrad; isotype, Gray); *Siebold*, as *L. umbellata* Gray; *Maximowicz*, as *L. umbellata* Thunb.; *Herb. K. Shiota, 46, 5517, 5939, 6486, 9662, 9692; T. Tanaka 42 (100185)*.

KOREA: *E. H. Wilson 9445, 9617; E. Taquet 3179*.

FORMOSA: *R. Oldham 446*.

CHINA. Chekiang: *S. Chen 60, 990, 1242, 2785, 2798, 2868,*

3714, 3730, 3909; H. H. Hu 303, 1692; W. C. Cheng 3684; S. S. Chien 735; Y. Y. Ho 913, 1449; Y. L. Keng 1044; R. C. Ching 1421, 1516, 1520, 2496, 2853, 4814, 5009, 5027, 5116, 5144; D. Macgregor, s. n., Ningpo, 1908. Fukien: *R. C. Ching 2505.* Anhwei: *S. C. Sun 1298, 1310, 1416, 1417; R. C. Ching 2853, 3198.* Kiangsu: *R. C. Ching & C. L. Tso 393.* Hupeh: *W. Y. Chun 3649; S. C. Sun 945, 1077, 1118.* Hunan: *W. T. Tsang 23517, 23606.* Kwangtung: *W. T. Tsang 26181.* Kwangsi: *T. S. Tsoong (Z. S. Chung) 81734, 81988; W. T. Tsang 27920.*

The Chinese specimens as a general rule have less grey bark than the typical Japanese material, and the leaves are often somewhat broader with less of a purple tinge below. There is no doubt, however, that they belong in the species.

Lindera sericea Blume, Mus. Bot. Lugd.-Bat. **1:** 324. 1851.

Lindera umbellata var. *sericea* Makino in Tokyo Bot. Mag. **14:** 185. 1900.

DISTRIBUTION: Japan.

JAPAN: *Blume* (TYPE *Lindera sericea,* fruit, Leiden; isotype, NY); specimen from Herb. Lugd.-Bat. in Gray Herbarium labeled *Benzoin sericeum S. & Z.; Herb. K. Shiota 49; K. Ichikawa 112.*

The species, as far as can be determined by the specimens at hand, does not occur in China. The large amount of material assigned to this species in the past, has proved to be *Litsea* and doubtfully *Litsea sericea.* The Chinese specimens (in fruit, of course), at first glance appear to be very much like the Japanese species, but they differ in the lower leaf surface being less pubescent at maturity, the pubescence of the young leaves being very tawny, and the mature leaves being more membranaceous than those of *Lindera sericea.* In shape, the leaves of the Chinese trees are more variable, usually with rounded and smaller leaves intermingled with the large acuminate leaves, and the fruiting pedicels and peduncles are very nearly equal in length, as opposed to the pedicels nearly two times the length of the peduncles in the Japanese species. The description of this new species of *Litsea* appears later in this paper. Most of the currently designated *Lindera umbellata* var. *sericea* from Japan were labeled thus because of the sericeous young leaves. On the same sheet are often mature leaves with scarcely a sign of pubescence except on the lower surface on the veins and the petioles, and that sparse pubescence is not of the soft villous kind to be found on the type of *Benzoin sericeum.* Therefore, these more or less glabrescent immature leaved specimens are undoubtedly true *Lindera umbellata* and not the variety *sericea.*

There is another possibility, which must be considered, and that is that there are perhaps two separate entities — *Lindera sericea* Blume, as outlined above, and distinct *L. umbellata sericea,* which shows little variation from *L. umbellata* proper. More complete and better material from Japan collected in all stages must be available to workers before the question of identities be settled satisfactorily.

Lindera sericea var. *β.* **glabrata** Blume, Mus. Bot. Lugd.-Bat. **1**: 324. 1851.

DISTRIBUTION: Japan.

The variety was under *Benzoin sericea* Blume on sheet from the Herbarium of Buitenzorg, and it may be the basis for all of the specimens labeled *Lindera umbellata* var. *sericea* from Japan. This specimen has smaller, more narrow leaves and is glabrescent. Because it is labeled *L. sericea* it may have been confused with true *L. sericea* of Blume, but might conceivably be his variety *glabrata.* Here also may be placed *A. Henry 79,* and *H. Mayr,* April 4, & June 15, 1886, from Ugo.

Lindera reflexa Hemsley in Jour. Linn. Soc. Bot. **26**: 391. 1891; Liou, Laurac. Chine Indoch. 128. 1932.

Lindera umbellata var. *latifolia* Gamble in Sargent, Pl. Wilson. **2**: 81. 1914.

Benzoin sericeum var. *tenue* Nakai, Fl. Sylv. Kor. **22**: 77. 1939.

For further synonymy, see Liou, l.c.

The type of *Lindera reflexa* is based on a specimen cultivated in the Hongkong Botanic Garden, from the North River above Canton. Most of the leaves on the type are rotundate-ovate, slightly cordate and obtuse, except for the leaves near the tip of the branch, which are obovate to elliptic and rounded at the base. None of the specimens accorded to *Lindera reflexa* exactly match the type, in leaf shape. For the most part, the latter are more acuminate at the apex, acutish at the base and rather elliptic in outline. The habit, pubescence and inflorescence are more stable and do not show such variation. It is a known fact that species in cultivation often show greater variation in young vegetative shoots. Hence, it is with no hesitation that the numbers below, in full leaf or fruit, are placed under *L. reflexa.* The young branchlets showing precocious flowers and very young leaves, however, might belong to any one of a number of species of eastern China. It is anyone's guess where they do belong. Gamble's variety *latifolia* of *Lindera umbellata,* from Hupeh, certainly has nothing to do with the species *L. umbellata.* The venation is of the same type as that of *L. reflexa,* the laterals arising almost horizontally from the midrib. There is less pubescence on Gamble's specimen, but no less than is to be found on many of the

so-called *L. reflexa* specimens. Gamble's variety is undoubtedly a poor specimen of the latter with slight geographical variation.

DISTRIBUTION: China.

KWANGTUNG: Hongkong Bot. Garden, cultivated, from North River, *No. 128* (TYPE of *Lindera reflexa,* Kew; photo & leaf tracing, AA), February 1, 1889; *CCC. 12194; W. T. Tsang 26337.* CHEKIANG: *R. C. Ching 2435, 4786, 4793, 5140, 5183; W. C. Cheng 2107; C. Y. Chiao 1019 (14318), 1044 (14343), 14436; H. H. Hu 1596; S. Chen 369, 495, 1157, 1519, 1676, 3150, 3209, 3679; Y. L. Keng 825, 994; W. Tang & W. Y. Hsia 382.* ANWHEI: *C. S. Fan & Y. Y. Li 164; S. C. Sun 1155; R. C. Ching 2627, 2746, 2820, 3119; S. S. Chien 1016; K. Ling 1151 (7731).* KIANGSI: *N. K. Ip 1064; H. H. Chung & S. C. Sun 337, 463; A. N. Steward 2749; E. H. Wilson 1621, 1632, 1639; A. Allison 10; J. L. Gressitt 1450; H. H. Hu 750 (?); T. H. Wang 232; S. K. Lau 4651.* HONAN: *A. N. Steward 1593 (9719).* HUNAN: *C. S. Fan & Y. Y. Li 156, 476.* HUPEH: *E. H. Wilson 610A* (TYPE of *Lindera umbellata* var. *latifolia,* fruit, Kew; photo & fragm. AA); *W. Y. Chun 5229.* KWEICHOW: *H. Handel-Mazzetti 255 (10765); W. Y. Chun 5782.* KWANGSI: *R. C. Ching 6143; C. Wang 41154; T. S. Tsoong (Z. S. Chung) 82032; W. T. Tsang 27606.* YUNNAN: *H. T. Tsai 57020 (?).*

All of the specimens from China cited by Nakai (see Nakai, l.c.) under *Benzoin sericeum* var. *tenue,* agree with the author's conception of *Lindera reflexa* as discussed above. Chen numbers 1239, 2765, cited by Nakai under *B. sericeum* var. *tenue,* the leaves of which are in very young stage, may be excepted, however, for in that condition it is difficult to determine the species.

Litsea szechuanica, spec. nov.

Arbor vel frutex parvus, 2.5–15 m. altus, ramulis fuscis vel atro-rubescentibus striatis glabris, novellis fulvo-tomentosis. Folia alterna, membranacea, elliptica vel obovata, 4–13 cm. longa et 2–6 cm. lata, rotundata, obtusata, acuta vel acuminata, basi acuta vel cuneata saepe inaequalia (rare, juventate rotundata), supra demum glabrescentia glabra (exceptis venis pubescentibus), viridia (fide collectoris), subtus primo fulvo-tomentosa demum glabrescentia, pallida, glauca, penninervia, nervis 6–8-jugis supra plus minusve inconspicuis subtus conspicue elevatis dense tomentosis, petiolo (5)–10–15 mm. longo pubescente. Inflorescentiae ♀ axillares. Umbellae ♀ 1–4, bracteis deciduis, pedunculatae, pedunculis 4–8 mm. longis pubescentibus. Flores 4-10 (?), 2–3 cm. longi, flavi (fide collectoris), glabrescentes, pedicellis 4–6

mm. longis gracilibus pubescentibus, lobis 6 oblongo-ellipticis 3 mm. longis, staminodiis 6, 2–(3) bi-glandulosis. Inflorescentiae ♂ axillares (?). Umbellae solitariae (?), bracteis deciduis, pedunculatae, pedunculis 3–4 mm. longis, pubescentibus. Flores 10 (?), 2–3 mm. longi, glabrescentes, pedicellis ± 10 mm. longis pubescentibus, lobis 6 ellipticis vel elliptico-obovatis ± 3 mm. longis, staminibus 9, 3 interioribus biglandulosis. Fructus parvus, subglobosus, breviter apiculatus, nigrescens, 3–4 mm. diam., disco plano haud crasso pubescente 1–2 mm. lato, pedicellis 10–12 mm. longis leviter crassis.

DISTRIBUTION: China (Szechuan, Yunnan, Shensi).

SZECHUAN: Kuan Hsien, Chien-Cheng Shan, *C. S. Fan & Class 139* (TYPE ♀, AA), April 4, 1938, alt. 1000 m., tree in forest, 30 ft. high, fl. yellow; Mt. Omei *F. T. Wang 23151,* July 2, 1931, alt. 1400 m., small tree 20 ft., diam. bh. 4 in., outside of temple, margin of thicket (fruit, AA); *Wang 20595, 20666, 20806, 22737; W. P. Fang 817; T. T. Yü 282, 418, 635, 705; E. H. Wilson 5176; S. S. Chien 5689.* YUNNAN: *H. T. Tsai 55967.* SHENSI: Tsinling-schan, centr. inter. mei et Liupa, in silvis mixtis den clivium *G. Fenzel 507,* May 1934 (♂, AA).

A species, the fruiting specimens of which have been placed under *Lindera umbellata, sericea* and even *glauca.* The very slender evidence that it is not a *Lindera* but a *Litsea* hangs on the dissection of a flower from an almost fragmentary branch tip with the specimen of *Fenzel 507.* Beyond a doubt, the fragment belongs with the rest of the material on the sheet, which matches the other members of the same species. The fulvous pubescence on the underleaf surface, concentrated into a tomentum on the younger parts of the plant, and the very small fruit set this species apart from the species of *Lindera* mentioned above. *Tsai no. 55967* and *Yü 635* and *705* are definitely a variant from the typical *L. szechuanica* and may even be another species. Whether *Lindera* or *Litsea* is impossible to say, because they are pistillate specimens.

There is a residue of specimens left after the disposal of the members of the *Lindera umbellata* complex. Whether they are *Lindera* or *Litsea* is difficult to say, since they are fruiting specimens. They do not match any material or description of known species. There are several species of *Litsea* among them *L. Forrestii* and *L. moupinensis* which were described from precocious flowers alone or flowers and very young leaves. It is anyone's guess what the mature leaves of these species may be. The following numbers are in this dubious position, each group probably representing a species.

YUNNAN: *T. T. Yü 16015.* SZECHUAN: *W. P. Fang 2210, 2863, 2915.* HUPEH: *W. Y. Chun 3888, 3908.*

Lindera tonkinensis Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris, sér. v, **5:** 112, t. 8. 1913, Fl. Gén. Indoch. **5:** 155, t. 7. 1914; Liou, Laurac. Chine Indoch. 133. 1932.

Lindera tonkinensis is a part of the general complex which holds *Lindera strychnifolia* var. *Hemsleyana* (*L. Hemsleyana*) and var. *velutina,* and *Lindera pulcherrima* (*L. Thomsonii*). *Ching 7863* was placed under *Lindera Chunii* Merrill, in an early determination. It is evident that geographically as well as physically it is distinct, since it occurs only in Indochina, and Hainan and Kwangsi in China. The western Chinese entities are totally different from the former species. The larger leaves which, like those of *L. Chunii,* remain greenish brown on drying, but unlike *L. Chunii,* are not shining but opaque and more membranaceous, acuminate instead of caudate, the total lack of glaucescence or pubescence on the lower leaf surface, the entirely basal origin of the lateral nerves, as opposed to their arising several millimeters above the base. These are characters which readily separate *Lindera tonkinensis.*

DISTRIBUTION: French Indo-China and China.

FRENCH INDO-CHINA. Tonkin: *E. Poilane 25194, 25306bis.* Annam: *Poilane 19850; F. Evrard 2134.* Laos: *E. Poilane 20029.*

CHINA. Kwangsi: *R. C. Ching 7863.* Hainan: *F. C. How 72649, 73790; C. Wang 36364.* Yunnan: *C. W. Wang 72833, 73258; J. F. Rock 2759, 2795; H. T. Tsai 53242; A. Henry 11686, 11686A, B, D.*

Lindera pulcherrima (Wallich) Hooker f., Fl. Brit. Ind. **5:** 185. 1886, p.p.

Daphnidium pulcherrimum (Wall.) Nees in Wall. Pl. As. Rar. **2:** 63. 1831, Syst. Laurin. 610. 1836.

Tetranthera pulcherrima Wall. Num. List. 2567A, 1830, nomen nudum.

Benzoin pulcherrimum O. Kuntze, Rev. Gen. **2:** 569. 1891.

DISTRIBUTION: India.

INDIA: Nepal, *Wallich 2567A,* in 1821 (TYPE of *Tetranthera pulcherrima,* Kew; isotype, Gray).

The true *Lindera pulcherrima* of Wallich and Nees, based on *Wallich 2567A* from Nepal, has oblong-lanceolate leaves measuring 10–15 cm. long and 2–4.5 cm. wide, with a slender cauda measuring sometimes as

much as 2–2.5 cm. in length, and glaucous below. The specimens which are at hand representing the type do not have fruit.

Lindera pulcherrima var. **attenuata,** var. nov.

A typo differt foliis lanceolatis concoloribus, apice attenuatis interdum subcaudatis, plus minusve manifeste 3-pli-nerviis, pedicellis brevioribus.

DISTRIBUTION: southwestern China (Kwangsi, Kweichow, Hunan, Hupeh, Kwangtung).

KWANGSI: Kwei-lin District, Hsi-chang village and vicinity, Ch'i fen-shan, *W. T. Tsang 28435,* October 1–11, 1937, shrub? 6 ft. high, with very young ♀ fls., (AA); Loh Hoh Tsuen, Ling Yün Hsien, *A. N. Steward & H. C. Cheo 79* (TYPE ♂, AA), March 23, 1933, forest alt. 1880 m., shrub 3 m. high, flowers yellowish; *Steward & Cheo 363; S. K. Lau 28806; T. S. Tsoong (Z. S. Chung) 83332.*

The Chinese material representing this variety, except for *Steward & Cheo 79* (♂ fl.) and *Tsang 28435* (♀ fl.), is in the fruiting stage. It differs from the species in having leaves less oblong and more narrowly ovate-lanceolate, with very attenuated tips hardly caudate as in *L. pulcherrima.* Considerable variation in leaf shape and size occurs but its presence is typical of this extremely variable group of plants. The variety may very possibly represent another species but because of the scarcity of material it seems advisable to designate it as a variety for the present. The last cited specimens have smaller leaves than the type, but they seem to belong in this category.

HUNAN: *C. S. Fan & Y. Y. Li 264; Handel-Mazzetti 670 (11107)* (fruit, AA), in monte Yün-schan prope urbem Wukang, in silva elata frondosa umbrosa copiose, alt. 900–1400 m. July 20, 1918, frutex aromaticus. HUPEH: *E. H. Wilson 3725.* KWANGTUNG: *S. P. Ko 52948.*

Lindera pulcherrima var. **glauca** Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris, sér. v, **5:** 117. 1913; Liou, Laurac. Chine Indoch. 135. 1932.

DISTRIBUTION: French Indo-China.

Only a photo of this variety is available. However, it seems to have been segregated, not from the true *L. pulcherrima,* but from the Hooker & Thomson specimen included in the latter (Hook. f., Fl. Brit. Ind. **5:** 185. 1886). It has the look of belonging with the species described below, but the description of Lecomte is scant and until the type itself is examined, no further disposition can be made.

Lindera Thomsonii, spec. nov.

Lindera pulcherrima Hooker f., Fl. Brit. Ind. 5: 185. 1886, p.p.

Arbor vel frutex 4–9 m. altus, ramulis teretibus striatis griseis vel rubescentibus glabris novellis dense sericeis exceptis, lenticellis conspicuis. Folia alterna, elliptica vel ovata, chartacea, 7–11 cm. longa et 2.5–4.5 cm. lata, longe caudata, cauda usque 3.5 cm. longa, basi acuta vel cuneata, utrinque glabra, bene reticulata, supra ± nitida, subtus glauca, 3-nervia, nervis utrinque conspicuis elevatisque, circa 5–9 mm. supra basim laminae divergentibus, saepe nervis lateralibus conspicuis supra medium laminae, petiolo usque 1.5 cm. longo glabro. Umbellae ♂ plerumque axillares, solitariae, brevipedunculatae, bracteis deciduis glabris. Flores 3–10, pubescentes, flavi (fide collectoris), 5–6 mm. longis, pedicellis 3–4 mm. longis fulvo-pubescentibus, lobis 6 oblongo-lanceolatis vel ovato-lanceolatis ± 3–5 mm. longis, staminibus 9, ± 4.5 mm. longis exsertis, 3 interioribus bi-glandulosis, ovario pubescente. Umbellae ♀ axillares, bracteis deciduis. Flores 4–12, pubescentes, albi, flavi vel viridescenti-flavi (fide collectoris), ± 3 mm. longis, pedicellis 4–5 mm. longis gracilibus fulvo-pubescentibus, lobis 6 oblongis ± 2 mm. longis, staminodiis ± 6, 1–2 plus minusve petaloideis, ovario ellipsoideo pubescente. Fructus ellipsoideus, 5–6 mm. longus, ± 3 mm. latus, nigrescens, disco parvo inconspicuo glabro, pedicello leviter crasso ± 1 cm. longo.

DISTRIBUTION: India, French Indo-China and China.

INDIA: Khasia: *J. D. Hooker & T. Thomson*, regio temp. alt. 5–7000 ft., (TYPE, fruit, Gray). Upper Burma: *F. K. Ward 9381, 9325; J. F. Rock 7409.*

FRENCH INDO-CHINA: Tonkin, *E. Poilane 19108.*

CHINA. Yunnan: Shweli River drainage basin and environs of Tengyueh, *J. F. Rock 8007* (TYPE ♂, AA), February 1923, shrub or small tree with yellow flowers; Chen Kang Hsien, near by village, *C. W. Wang 72528* (♀, AA), March 1936, alt. 2000 m., tree? 4 m. high, flowers greenish yellow; *C. W. Wang 72474; G. Forrest 9517, 26243, 26259; H. T. Tsai 56361, 56362; A. Henry 9629.* SZECHUAN: *E. Faber 242.*

A species exceedingly variable in leaf shape, except for the drip-tip, which is constant throughout. The leaves are conspicuously reticulate after the pattern of all leaves of this group. Hooker placed his specimen from Khasia under *L. pulcherrima* amending the original description to include it. Subsequent workers have done likewise until *L. pulcherrima* has become even more variable as a species and its range

been extended to include all of southeastern Asia. All of these broader and shorter elliptic leaved caudate specimens, however, belong under *L. Thomsonii*. The young leaves and stems are tawny-sericeous but lose their pubescence early, the lower surface of the leaves being glaucous at maturity. Both the pistillate and staminate flowers are tawny-pubescent, the staminate being larger throughout and more pubescent.

The following numbers in fruiting stage are probably variations within the species of *L. Thomsonii*. KWANGSI: *S. P. Ko 56028*. YUNNAN: *T. T. Yü 17089, 17267; C. W. Wang 67078, 67304, 67350*.

The species is named for Mr. T. Thomson, co-collector with J. D. Hooker in India.

Lindera urophylla (Rehder), comb. nov.

Benzoin urophyllum Rehder in Jour. Arnold Arb. **1**: 146. 1919; Chun in Contr. Biol. Lab. Sci. Soc. China 1^5: 52. 1925.

Lindera caudata Diels in Engl. Bot. Jahrb. **29**: 352. 1901, non (Nees) Ktze.

DISTRIBUTION: western China (Szechuan, Kweichow).

SZECHUAN: *C. Bock & A. v. Rosthorn 781* (TYPE of *Lindera caudata*, Berlin; photo & fragm., AA); *Y. Liu 1424*. KWEICHOW: *Y. Tsiang 6457*.

A species as yet known only in the fruiting stage. The plant is slender, glabrous throughout and the leaves have the patterned reticulation and drip-tip usual for this group. The leaves are almost membranaceous, are pale green and strikingly glaucous below.

Lindera subcaudata (Merr.) Merrill in Philip. Jour. Sci. **15**: 237. 1919; Liou, Laurac. Chine Indoch. 133. 1932.

Neolitsea subcaudata Merrill in Philip. Jour. Sci. **13**: 137. 1918.

Benzoin subcaudatum (Merr.) W. Y. Chun in Contr. Biol. Lab. Sci. Soc. China 1^5: 38. 1925.

DISTRIBUTION: southeastern China (Kwangtung).

KWANGTUNG: *C. O. Levine 1351* (TYPE, fruit, Manila; isotype, Gray, AA); *Merrill 11016; To Kang Peng 2707* (♂ , Manila); *C. O. Levine & F. A. McClure 7027; T. M. Tsui 71*.

The species was first described from fruiting specimens only, under *Neolitsea*, but when staminate material was available the new combination under *Lindera* was made. Tsui's specimen from Loh-Fau Shan is a staminate flowering branch. The leaves are more elliptic than oblong and are wider accordingly than are those of the pistillate plant.

Lindera supracostata Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris, sér. v, **5**: 112. 1913; Liou, Laurac. Chine Indoch. 132. 1932. For further synonymy, see Liou, l.c.

DISTRIBUTION: western China (Yunnan).

YUNNAN: *J. M. Delavay 2579* (SYNTYPE, Paris; isosyntype, AA), *3996; H. T. Tsai 57555, 52939, 57319, 58370; T. T. Yü 8151, 17026; Siméon Ten 577; A. Henry 10873; G. Forrest 10615, 27394; E. E. Maire 228, 465.*

A striking species with very pale green 3-nerved acuminate leaves shining above and conspicuously reticulate in the pattern usual for the group, with costa and laterals very prominently reticulate; below, nervation less conspicuous, but the veins standing out yellowish against the glaucous background. There is a tendency toward a rhomboid base, pronounced in some leaves and scarcely discernible in others on the same branch. Frequently the tendency is manifest only in a slight inequality at the base of the leaf. *Yü 17026* has leaves smaller in the main and more bluntly and abruptly acuminate than those of the other specimens, but none the less certainly belongs with *L. supracostata.*

Lindera supracostata var. **attenuata,** var. nov.

A typo differt foliis tenuioribus attenuatioribus angustioribus.

DISTRIBUTION: western China (Yunnan, Szechuan).

YUNNAN: *G. Forrest 11110* (TYPE ♀, AA); between Likiang, Tungshan, Tuinaoko, and Tsilikiang, dry Yangtze drainage basin, *J. F. Rock 9783* (fruit, AA), May 1923, alt. 9000 ft., shrub 8–10 ft.; *H. T. Tsai 57336.* SZECHUAN: *C. Schneider 754.*

Differs only in the more narrow and more attenuate leaves, not surpassing 2.3 cm. in width. The tendency toward a rhomboid base is less apparent than in the species.

Lindera Vernayana, spec. nov.

Frutex parvus, ramulis teretibus griseis gracilioribus primo adpresse pubescentibus demum glabris. Folia alterna, membranacea, elliptica, 7–9 cm. longa et 2–3 cm. lata, longe caudata, cauda ± 2 cm. longa, saepe falcata, basi acuta, pallide viridia, supra opaca, glabra, bene reticulata, subtus tota facie breviter adpresse argenteo-sericea, 3-nervia, nervis utrinque conspicuis, circa 1–2 mm. supra basim laminae divergentibus, petiolo 5–(9) mm. longo tenui glabrescente demum glabro. Umbellae ♂ axillares, brevi-pedunculatae, bracteis deciduis. Flores 5–8, sparse pubescentes, pedicellis 1–2 mm. longis tenuibus pubescentibus, lobis 7–8 ellipticis extus sparse pubescentibus, staminibus 9. Umbellae ♀ et fructus ignoti.

DISTRIBUTION: Upper Burma and China.

UPPER BURMA: Panwa Pass, *F. K. Ward (Vernay-Cutting Exped.) 405* (TYPE, AA), March 15, 1939, evergreen forest, alt. 2135 m., small shrub with leaves silver beneath with appressed silky hairs.

CHINA: Yunnan, *H. T. Tsai 55976.*

A new species at first glance difficult to separate from *Lindera Thomsonii* and *L. Hemsleyana* var. *velutina.* The more slender, pale grey branchlets, narrower leaves with shorter appressed silky pubescence, persisting in the flowering stage on adult leaves, distinguish it easily. It is named for Mr. Vernay, who with Mr. Cutting made possible the recent expedition into Burma.

Lindera Hemsleyana (Diels), comb. nov.

Lindera strychnifolia F.-Vill. var. *Hemsleyana* Diels in Bot. Jahrb. **29**: 352. 1901; Gamble in Sargent, Pl. Wilson. **2**: 83. 1914; Liou, Laurac. Chine Indoch. 136. 1932.

Lindera strychnifolia var. ? Hemsl. in Jour. Linn. Soc. Bot. **26**: 392. 1891.

Benzoin strychnifolium O. Ktze. var. *Hemsleyanum* (Diels) Rehder in Jour. Arnold Arb. **1**: 145. 1919; W. Y. Chun in Contr. Biol. Lab. Sci. Soc. China 1^5: 41. 1925.

DISTRIBUTION: southeastern China.

For years this entity has persisted as a variety of *L. strychnifolia,* with which it actually has very little in common. The latter species is affiliated with the group which contains *L. Chunii, L. caudata,* etc. which for the most part lacks the striking, patterned reticulation apparent on the upper surface. With the elevation of this variety to specific rank and the acknowledgment of a variety or so in conjunction with it, it is to be hoped that this particular section of the genus will become less confusing in the future.

The species is distinct from the others in the group for the almost velutinous lower leaf surface, which on older branchlets becomes merely glaucous, and for the acuminate rather than caudate leaf tips.

Lindera Hemsleyana var. **velutina** (Forrest), comb. nov.

Lindera strychnifolia F.-Vill. var. *velutina* Forrest in Not. Bot. Gard. Edinb. **13**: 166. 1921.

DISTRIBUTION: China (Yunnan) and Upper Burma.

CHINA. Yunnan: *G. Forrest 15928* (SYNTYPE, Edinb.; isosyntype, AA); *17658* (SYNTYPE, Edinb.; isosyntype, AA); *J. F. Rock 7631; C. W. Wang 72058.*

UPPER BURMA: *F. K. Ward (Vernay-Cutting Exped.) 430, 457.*

It seems that this species, as viewed from description and the two syntypes available, is hardly velutinous on the lower leaf surface but rather more sericeous. The long silky hairs apparent in early stages become sparse and dark with age, until on the older branchlets there is only an occasional patch of hairs left to indicate the former heavy pubescence. This last feature, the variety has in common with its erstwhile species *L. strychnifolia*.

Lindera Stewardiana, spec. nov.

Arbor vel frutex 5 m. altus, ramulis teretibus, novellis angulatis striatis in sicco rubro-brunnescentibus (griseis fide collectoris) glabris. Folia alterna, lanceolata vel lanceolato-elliptica, subcoriacea, 9–12 cm. longa et 2.5–4 cm. lata, plus minusve acuminata, basi acuta, utrinque glabra, supra conspicue reticulata, nitida, viridia, subtus glauca, 3-nervia (haud 3-pli-nervia), nervis supra plus minusve conspicuis subtus prominenter elevatis, petiolo 1–1.5 cm. longo glabro. Inflorescentiae numerosae axillares, umbellatae. Umbellae ♂ 2–6–(?), subsessiles vel brevipedunculatae, bracteis rotundatis vel ovatis argenteo-sericeis deciduis. Flores 4–7–(?), pubescentes, flavi, fragrantes (fide collectoris), pedicellis 3–5 mm. longis dense ferrugineo-pubescentibus, lobis 6 ellipticis subaequalibus ± 2.5 mm. longis, staminibus 9 exsertis ± 4.5–5 mm. longis, 3 interioribus bi-glandulosis. Fructus immaturus, ellipsoideus, apiculatus, disco pubescente, plano haud crasso, pedicello 7–10 mm. longo pubescente leviter crasso.

DISTRIBUTION: western China (Kwangsi).

KWANGSI: *A. N. Steward & H. C. Cheo 3* (TYPE ♂, AA), Loh Hoh Tsuen, Ling Yun Hsien, March 12, 1933, alt. 1150 m., brushy rocky slope, tree 5 m. high, fl. yellow, fragrant, bark grey, leaves used for making incense; valley in Chin-Tong, *Steward & Cheo 397*, alt. 1300 m., ? vine on tree? (young fruit, AA); *R. C. Ching 5835; S. P. Ko 55793*.

A beautiful species striking because of the luxuriance of the staminate flowers and the shining leaves, glaucous on the lower surface. It is near *L. pulcherrima* from India. The infrutescence also is as abundantly full-fruited and consists of as numerous umbels accordingly as the inflorescence of the staminate branchlets. The other specimens cited do not have such an abundance of fruit as the type material. *Steward and Cheo 397* on the field label gives the information that the plant is a vine on a tree. Undoubtedly, there must have been an error in copying, for the specimen is certainly from a tree or at least a shrub.

The species is named for Dr. A. N. Steward, senior collector of the type and Professor of Botany at Nanking University.

Lindera Gambleana, spec. nov.

Arbor parva, 1.5–6–(9) m. alta, ramulis teretibus striatis fuscis, novellis pallide virescentibus glabris. Folia alterna, lanceolato-oblonga vel lanceolato-elliptica, subcoriacea, 8–12 cm. longa et 2–4.5 cm. lata, acuminata, basi acuta vel cuneata, utrinque glabra, supra viridia, subtus glauca (fide collectoris), 3-pli-nerviis, nervis supra minus conspicuis quam subtus, subtus elevatis circa 3–5 mm. supra basim laminae divergentibus, supra medium nervis ca. 1–2 lateralibus subtus conspicuis, petiolo 1–1.5 cm. longo glabro. Inflorescentiae ♂ numerosae, axillares umbellatae. Umbellae 2–6–(?), subsessiles vel brevi-pedunculatae, pubescentes, bracteis deciduis pubescentibus. Flores 4–8–(?) pubescentes, flavescenti-albi (fide collectoris), pedicellis 3–4 mm. longis dense fulvo-pubescentibus, lobis 6 oblongis ± subaequalibus ± 4 mm. longis, staminibus 9 ± 3.5 mm. longis, 3 interioribus bi-glandulosis. Umbellae ♀ 1–3, brevi-pedunculatae, bracteis plus minusve persistentibus. Flores 4–8–(?), pubescentes, flavescenti-albi vel viridescenti (fide collectoris), brevi-pedicellati, pedicellis ± 1 mm. longis pubescentibus, lobis 6 oblongis ± 2.5 mm. longis, staminodiis 9, ovario obovoideo glabro. Fructus ignotus.

DISTRIBUTION: western China (Szechuan).

SZECHUAN: Mt. Omei, *T. T. Yü 495* (TYPE ♂, AA), April 22, 1932, alt. 2400 m., mt. slope among conifers, tree 12 ft., leaves dark green above, bluish beneath, flowers yellowish white; Mt. Omei, *T. T. Yü 494* (♀, AA), April 22, 1932, under Abies forest, tree 20 ft., d.b.h. 5 in., bark dark grey, leaves dark green above, bluish beneath, flowers yellowish white; *Yü 384, 487; E. H. Wilson 5181; W. P. Fang 2268* (?); *F. T. Wang 23152, 23152 C* (?).

A species near *Lindera Stewardiana,* but separated by firmer, 3-pli-nerved leaves not shining above, with less prominent reticulation and more prominent lateral veins on the lower surface above the middle of the leaf. The flowers are less abundant with shorter pedicels and more appressed pubescence on the lobes.

The species is named in honor of Dr. J. S. Gamble, who determined the Lauraceae of E. H. Wilson's western Chinese collections published in Sargent's Plantae Wilsonianae.

The following specimens are listed as possibly being the fruiting specimens of *L. Gambleana.* There are differences apparent in the near-caudate rather than acuminate tip, the tendency toward smaller leaves in some cases and in others larger leaves. Perhaps some of these are variations typical of the pistillate tree. There are undoubtedly more

than one entities represented here, but they cannot be separated without the study of more representative material.

KWANGSI: *C. Wang 40997.* SZECHUAN: *F. T. Wang 23264; T. T. Yü 373, 447; C. Y. Chiao & C. S. Fan 301.* YUNNAN: *H. T. Tsai 52325, 52280, 54801, 56605, 58416; T. T. Yü 20412.*

Lindera Gambleana var. **floribunda,** var. nov.

A typo differt ramulis novellis dense fulvo-sericeis, junioribus pubescentibus, foliis subtus velutinis, petiolis pubescentibus, floribus numerosis dense aggregatis, pedicellis ± 4 mm. longis.

DISTRIBUTION: western China (Yunnan).

YUNNAN: *G. Forrest 9773* (TYPE ♂, AA); *G. Forrest 7585* (young fruit, AA), *9621; T. T. Yü 16395* (?).

A very attractive tree particularly when young branchlets are growing out, but undoubtedly a variety of *L. Gambleana.* In the abundance of inflorescences both staminate and pistillate it recalls *L. Stewardiana,* but is quickly discernible from the species by the pubescence on the lower leaf surface.

Lindera strychnifolia F.-Vill. in Blanco, Fl. Filip. ed. 3, Nov. Append. 182. 1880; Liou, Laurac. Chine Indoch. 136. 1932. For further synonymy see Liou, l.c.

DISTRIBUTION: eastern Asia and the Philippines.

There has long been confusion centering about this species, and related species such as *L. caudata, L. Chunii, L. rufa, L. Eberhardtii,* and *L. Playfairii.* All species have more or less ovate leaves which are long-acuminate to extremely long-caudate, glaucous or pubescent below, tri- or tri-pli-nerved. These characters intergrade with a facility that renders clear-cut definition of the species very difficult. All the above mentioned species are distinguished from *L. strychnifolia* proper by the fact that in the latter species the leaves are always ovate-rotund. *Lindera strychnifolia* var. *Hemsleyana* (*L. Hemsleyana*) and var. *velutina,* together with their related entities, belong in a group distinct from and never confused with the "caudata" complex. The leaves of the former are usually prominently reticulate on the upper surface, and the transverse veins, parallel with each other and oblique to the midrib and two laterals, form a distinct pattern peculiar to the group and lacking in the "caudata" complex. These species and varieties are being discussed below.

Lindera caudata Hooker f., Fl. Brit. Ind. **5:** 184. 1886; Liou, Laurac. Chine Indoch. 133. 1932. For further synonymy, see Liou, l.c.

DISTRIBUTION: India, French Indo-China, and China.

FRENCH INDO-CHINA. Laos: *E. Poilane 25617.* Cochinchina: *F. Evrard 1988, 2252.*

CHINA. Kwangsi: *R. C. Ching 6834, 7948; W. T. Tsang 22121, 22242, 22621, 23983, 24680.*. Yunnan: *T. T. Yü 16236.*

Lindera caudata is separated easily by its 3-nerved, always pubescent leaves, in which the three nerves are very prominent and pubescent in all stages, persisting to near the tip of the leaf. The leaf itself is more often oblong-elliptic than ovate. In spite of the name, the species is more long-acuminate than definitely caudate. The branchlets and petioles are pubescent and the umbels sessile.

Lindera rufa Gamble in Jour. As. Soc. Bengal. **75:** 200. 1912; Liou, Laurac. Chine Indoch. 132. 1932. For further synonymy see Liou, l.c.

DISTRIBUTION: Malaya and China?

Reported by Liou from Kweichow. The species can be set apart by its ovate, long-acuminate leaves which are tawny-villous when young, becoming glaucous with age. The petioles are persistently pubescent. The nervation is 3-pli-nerved, the nerves fading out above the middle of the leaf. The young branchlets and buds are densely ferrugineous-tomentose, the pubescence later becoming darker. *Poilane 975* from French Indo-China may belong here. The leaves are more 3-nerviate than 3-pli-nerviate and may or may not be glaucous underneath, after losing their early tawny or pale-ferrugineous pubescence.

Lindera Chunii Merrill in Lingnan Sci. Jour. **7:** 307. 1929; Liou, Laurac. Chine Indoch. 133. 1932.

DISTRIBUTION: southeastern China.

Lindera Chunii stands out among these species because of the bright green upper surface of the leaves and the lower surface covered with closely appressed dense silvery, golden or coppery pubescence, the color depending on the age of the branch at the time of gathering. The leaves are definitely caudate and 3-pli-nerved. The umbels are truly pedunculate.

KWANGSI: *T. S. Tsoong* (*Z. S. Chung*) *82186.* KWANGTUNG: *W. Y. Chun 6327* (TYPE ♀, Manila; isotype, AA).

Lindera Playfairii (Hemsl.) Allen in Ann. Missouri Bot. Gard. **25:** 400. 1938 (preprint 1937).

Litsea? Playfairii Hemsl. in Jour. Linn. Soc. Bot. **26:** 384. 1891.
Neolitsea Playfairii (Hemsl.) Chun in Contr. Biol. Lab. Sci. Soc. China.

1°: 66. 1925; Liou, Laurac. Chine Indoch. 145, t. 1932.
Lindera alongensis Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris, sér. v, **5**: 118. 1913.

DISTRIBUTION: China and French Indo-China.

CHINA. Kwangtung: *G. M. Playfair* (TYPE *Litsea? Playfairii*, ♂ Kew; photo & fragm. AA). Kwangsi: *H. Y. Liang 69330; F. C. How 73871.*

FRENCH INDO-CHINA. Tonkin: *H. Lecomte & A. Finet 823* (TYPE of *L. alongensis* Paris; photo, AA).

The two species *L. Playfairii* and *L. alongensis* are conspecific, as far as can be told from the descriptions and photographs of the types available. The type of *L. Playfairii* is staminate, while that of *L. alongensis* is pistillate.

Lindera Eberhardtii Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris, sér. v, **5**: 115. 1913, Fl. Gén. Indoch. **5**: 156. 1914; Liou, Laurac. Chine Indoch. 135. 1932.

DISTRIBUTION: French Indo-China.

The species differs from *Lindera Playfairii* in that the leaves are pilose as well as glaucous below. The nervation, according to Lecomte, is 3-nerved, like that of *L. Playfairii* and his *L. alongensis*, but the nerves arise a few millimeters above the base. It differs from *L. rufa* in the absence of ferrugineous pubescence on the young leaves and branchlets.

Lindera flavinervia, spec. nov.

Arbor 9–15 m. alta, ramulis angulatis striatis rugosis fuscis, glabris. Folia alterna, late elliptica, membranacea, 6–12 cm. longa et 3.5–6.5 cm. lata, acuta vel breviter acuminata, basi rotundata vel cuneata, utrinque glabra, supra bene reticulata, viridia, subtus pallida vel leviter glauca, 3-nervia, nervis utrinque conspicuis elevatisque flavis circa 5–9 mm. supra basim laminae divergentibus, ± 6 nervis lateralibus plus minusve conspicuis, petiolo 1.5–2.5 cm. longo glabro. Umbellae ♂ plures, axillares, subsessiles, bracteis deciduis. Flores parvi, ± 6, glabri, virides (fide collectoris), pedicellis ± 5 mm. longis minute pubescentibus, lobis 6, 3 interioribus ovato-ellipticis ± 3–4 mm. longis, 3 exterioribus late ovatis ± 1.5–2 mm. longis, staminibus 9, parvis inclusis, 3 interioribus bi-glandulosis. Fructus subglobosus, ± 8 mm. diam., nigrescens (viridis, fide collectoris), cupula glabra 2–3 mm. longa ± 4 mm. lata, pedicello ± 8 mm. longo, crasso. Umbellae ♀ immaturae.

DISTRIBUTION: China (Yunnan).

YUNNAN: Mienning, Hopientsun, *T. T. Yü 18160* (TYPE ♂, AA),

Nov. 2, 1938, alt. 2100 m., tree 4.5–6 m. high, flower green, common among forest; Chenkang, Snow Range, Tapingchang, *Yü 17245*, Aug. 6, 1938, at 2350 m. alt., tree 9–15 m. high, common among forest (fruit, AA).

Near *Lindera fruticosa* Hemsl.[1] but differing in abundant, many flowered sessile inflorescences with short-pedicelled flowers, thicker leaves with distinct venation, and more numerous lateral veins. Also, the small glabrous flowers with the three inner lobes nearly twice as large as the three outer ones, set the species apart at once.

Here tentatively might be placed *C. W. Wang No. 73085* from Shung-Kiang on mountain slope at 2200 m. altitude. The specimen has leaves less distinctly veined, larger and less firm, but the general habit and fruit indicate an affiliation with *Lindera flavinervia*.

Herbarium, Arnold Arboretum,
Harvard University.

[1] *Lindera fruticosa* Hemsl. in Jour. Linn. Soc. Bot. **26**: 388. 1891; Allen in Ann. Missouri Bot. Gard. **25**: 399. 1938 (preprint 1937).

PLANTAE PAPUANAE ARCHBOLDIANAE, V*

E. D. MERRILL AND L. M. PERRY

RUTACEAE

IN THIS PAPER we propose only to record a number of apparently new species and a few range-extensions which have appeared in our effort to name the Rutaceae (excluding the Aurantioideae) of the Archbold collections. By far the major part of the material belongs to the *Evodia-Melicope-Acronychia* group of genera. Although, in Engler's classification, the last genus is placed in another section (with indehiscent fruit) far from the *Evodia-Melicope* relationship, it is to be remembered that species have been transferred from both of these genera to *Acronychia*. In most instances it has been relatively easy to separate *Evodia* from *Melicope*, the former having only four stamens, the latter eight. Unless the fruit is fully mature, the genus may be distinguished from the number or the position of the stamens persisting somewhere on the infructescence. To separate *Acronychia* with dehiscent fruit is another problem. Here are either four stamens (as in *Evodia*) or eight (as in *Melicope*) with filaments glabrous or hairy within toward the base. After scanning our meager material and the descriptions of the species from Australia and Polynesia included in *Acronychia*, it seemed the one differential character was probably the compound ovary. Yet, after examining the collections from the Solomon Islands, some of which show fruits with carpels united to the apex and more or less deeply lobed, others with carpels united halfway to the apex, some with four stamens, others with eight, and some staminate material with rudimentary carpels below the level of the disk, we have decided that our material is too scanty for us to make more than a provisional assignment. We believe this material to be more closely allied to *Evodia* and *Melicope* than to *Acronychia*, although possibly it belongs to a section of *Acronychia* with small flowers and thin dehiscent capsules.

Zanthoxylum L.

Zanthoxylum Dominianum nom. nov.

Fagara varians Domin, Bibl. Bot. **89**: 846. 1927.

BRITISH NEW GUINEA: Western Division, Lower Fly River, east

*(Botanical Results of the Richard Archbold Expeditions) See Jour. Arnold Arb. **20**: 324–345. 1939; op. cit. **21**: 163–200, *t. 1*. 1940; op. cit. 292–327; op. cit. 511–527.

bank opposite Sturt Island, *Brass 8060,* October 1936, common on ridges in rain-forest (weak undergrowth tree 2–3 m. high; leaves aromatic; flowers white); Wassi Kussa River, Tarara, *Brass 8507,* December 1936, common at margin of rain-forest (shrub or small tree 1.5–5 m. high, leaves greyish above; flowers white).

These staminate collections appear to agree reasonably well with Domin's description of this Queensland species. One leaf of *Brass 8060* has a terminal leaflet 18 cm. long, 7 cm. broad, but both plants are surely conspecific and the other number falls well within the limits of *Z. Dominianum.* This species is very closely allied to the Malaysian *Z. ovalifolium* Wight. The specific name *varians* is pre-empted in the genus *Zanthoxylum.*

Zanthoxylum Rhetsa (Roxb.) DC. Prodr. **1:** 728. 1824; Merr. Enum. Philip. Fl. Pl. **2:** 327. 1923.

Fagara Rhetsa Roxb. Fl. Ind. **1:** 438. 1820; Koord. & Val. Atlas Baumart. Java **2:** *t. 352.* 1914.

Solomon Islands: Ysabel Island, Sigana, *Brass 3449,* January 1933, alt. 100 m., hill rain-forests (large wide spreading tree with pale fissured bark and very bright yellow wood; leaves with pale nerves; flowers white).

We have assigned this collection to the Malaysian *Zanthoxylum Rhetsa* (Roxb.) DC. as interpreted in its broader sense. Possibly more mature material will prove it to be a distinct species.

Belonging in this same alliance but surely not identical with it is the following collection from British New Guinea: Western Division, Mabaduan, *Brass 6491,* April 1936, very common monsoon-forest substage tree (20 m. high, crown somewhat spreading; bark pale brown, inner bark and wood yellow; lower part of stem covered with large limpet-like thorny processes; small red aromatic fruit; seeds black). The fruit is about 7 mm. long, the epicarp is densely glandular-pustulate; the thorny processes are 3–3.5 cm. diameter at the base; the leaves have 5–8 pairs of obliquely ovate to elliptic leaflets.

Zanthoxylum conspersipunctatum sp. nov.

Arbor gracilis, 5 m. alta; ramulis parce aculeatis; foliis 2–4-jugis, pari- atque impari-pinnatis; petiolo ac rhachi 6.5–19 cm. longis, glabris; foliolis petiolulatis (petiolulis 3–6 mm. longis), tenuiter coriaceis, superioribus oblongis, inferioribus ovato-ellipticis, 4–12 cm. longis, 1.5–4 cm. latis, basi oblique rotundatis ad suboblique cuneatis, apice acuminatis (acumine ± 1 cm. longo), margine crenulatis, utrinque

glabris, consperse pellucido-punctatis (glandulis magnis, interdum sine lente manifestis), costa subtus prominente; venis primariis utrinsecus 9–11, patenti-adscendentibus, prope marginem arcuatim anastomosantibus, supra manifestis subtus perspicuis; venulis laxe reticulatis, utrinque ± manifestis; paniculis terminalibus, quam foliis brevioribus, glabris; pedicellis brevissimis; calyce ultra medium 4-lobato, lobis vix 1 mm. longis, ovatis, acutiusculis; petalis 4 mm. longis, vix 1.5 mm. latis; staminibus 4 cum petalis alternantibus; filamentis 3.5 mm. longis, subapplanatis; antheris ellipsoideis, 2 mm. longis; ovario ovato, disco inconspicuo obtuso, 1 mm. longo; stylo terminali sed excentrico, brevissimo.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, *Brass 11579* (TYPE), November 1938, alt. 2300 m., one plant in forest undergrowth (slender tree 5 m. high; flowers white).

The species belongs to the section *Blackburnia* (Forst.) Engler. The leaves are mostly even pinnate, exceedingly variable in size, but all have the somewhat scattered large pellucid glands. Possibly its alliance is with *Z. parviflorum* Bentham.

Evodia Forst.

Evodia Forst. with 33 already published species is the largest genus of the Rutaceae in Papuasia. We add here 12 more species. Lauterbach's key to the genus is divided into series based on foliar characters. In our material it appears as if a fairly logical division of the genus might be made on the size of the flowers and the cocci. The latter in the larger-flowered species are often sericeous-pubescent within.

Evodia oligantha sp. nov.

Arbor parva, 3–5 m. alta; ramulis novellis obtuse quadrangularibus, valde compressis, glabris, in sicco rubiginosis; foliis ternatis; petiolo 1–1.5 cm. longo, glabro, supra applanato; foliolis petiolulatis (petiolulis circiter 4–6 mm. longis, glabris, canaliculatis), coriaceis, olivaceis, late lanceolatis vel leviter oblanceolatis, 3.5–7 cm. longis, 1.5–3 cm. latis, basi acute cuneatis, apice acutiusculis vel breviter obtuse acuminatis, utrinque glabris, novellis copiose glanduloso-punctatis; venis primariis utrinsecus 8–12, supra inconspicuis, subtus manifestis, subhorizontalibus prope marginem arcuatim anastomosantibus; venulis laxe reticulatis; paniculis axillaribus, 5–8 cm. longis, paucifloris, habitu subumbellatis; pedunculis 3.5–5 cm. longis; ramulis brevibus, basi bracteatis (bracteis foliiformibus, usque 2 cm. longis, 7 mm. latis, basi angustatis); pedicellis 4 mm. longis, glabris; sepalis liberis, concavis, late rotundatis, 3 mm.

longis, 4 mm. latis, glanduloso-pustulatis; petalis 6–7 mm. longis, 3 mm. latis, apice inflexo-apiculatis, extus consperse glanduloso-pustulatis, intus basim versus puberulis; staminibus circiter 5 mm. longis, filamentis ad basim (1 mm. latis) parce pilosulis, ad apicem (0.6 mm. latis) glabris, antheris 1.5 mm. longis; disco glabro, crasso, 1 mm. alto; carpellis 4, usque ⅓ longitudinem connatis, glabris; stylis connatis, 0.5 mm. longis, glabris; stigmate capitato, inconspicue 4-lobato.

Netherlands New Guinea: Lake Habbema, *Brass 9365* (type), August 1938, alt. 3225 m., one of the smaller and least common trees in closed forest (3–5 m. high; flowers green).

This interesting species is readily distinguished from the other members of the genus in New Guinea by the long-peduncled and relatively few-flowered inflorescences with leaf-like bracts subtending the short branches, and by the almost glabrous floral parts.

Evodia crispula sp. nov.

Arbor probabiliter; ramulis ad apicem minute tomentosis, mox glabratis, ad nodos valde compressis; foliis ternatis; petiolo 4–8 cm. longo, supra subcanaliculato, tomentuloso ad glabrato; foliolis petiolulatis (petiolulis 5–9 mm. longis, canaliculatis, tomentulosis), coriaceis, ellipticis (in specimine typico 9–14 cm. longis, 3.5–7 cm. latis), basi subrotundatis vel obtusis, interdum cuneatis, apice acuminatis, minute pellucido-punctatis, supra glabris, subtus praecipue in costa atque venis primariis crispule stellato-pilosulis; venis primariis utrinque 14–16, supra impressis, subtus prominulis, oblique adscendentibus, prope marginem arcuatim confluentibus; venulis vix manifestis; paniculis saepissime ex axillis foliorum delapsorum ortis, 5–7 cm. longis pedunculo 2–2.5 cm. longo incluso, multifloris; axi, ramulis pedicellisque tomentulosis ad dense puberulis; sepalis 1.2 mm. longis, ad basim connatis, apice rotundatis, puberulis; petalis 5 mm. longis, 3 mm. latis, apice inflexo-apiculatis, extus puberulis, intus dense sericeo-pubescentibus; staminibus 4, filamentis 8–9 mm. longis, intus in parte inferiore piloso-tomentulosis; antheris circiter 2 mm. longis; disco vix 1 mm. alto, tomentoso, subangulato; ovario 4-partito, villosulo; stylo 4.5 mm. longo, pubescente; fructibus ignotis.

Northeastern New Guinea: Morobe District, Ogeramnang, *Clemens 6357* (type), *5155,* May and January 1937, alt. ± 1750 m.

Possibly *Clemens 5921,* Ogeramnang, and *Clemens 2238,* Quembung, also belong here. Both have very immature flowers; the leaves are much larger (13–19 cm. long, 7.5–9.5 cm. broad) but similar in outline and in the somewhat crisped stellate pubescence on the lower surface.

The flower of *Evodia crispula* is very much like that of *E. trichopetala* Lauterb. in that the petals are hairy on both sides, the lower half of the inner surface of the filaments is clothed with more or less tangled hairs, the disk is tomentose and the carpels are short villous. The latter species, however, is glabrous in all the vegetative characters.

Evodia trichopetala Lauterb. Nov. Guin. **14:** 139. 1924.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, *Brass & Versteegh 10457, 10457a, Brass 10709,* October 1938, alt. 2830 m., 2750 m., 2800 m. respectively, common in secondary forest (tree 12–18 m. high; flowers red); Bele River, 18 km. northeast of Lake Habbema, *Brass 11378,* November 1938, alt. 2200 m., secondary rain-forest near river (tree 10 m. high; flowers red).

These collections have elliptic rather than lanceolate leaflets, sepals almost 2 mm. long and a style only 3 mm. long. Yet, in view of the agreement of the other floral and foliar characters with the original description, we have assigned the collections to this species. The fruit of *10457a* is about mature. The cocci, 8 mm. long, are already open, the exocarp is 1 mm. thick, closely and longitudinally rugose, glabrous and densely glandular, the inner surface of the endocarp is yellowish with a sericeous pubescence. The seeds are black, shining, 5 mm. long, and somewhat obliquely ovoid.

Possibly *Brass & Versteegh 11998* also belongs here. The specimen shows young fruit. The leaflets are lanceolate, not so distinctly coriaceous, and dull.

Evodia rosea sp. nov.

Arbor; ramulis teretibus ad nodos leviter compressis, glabris, innovationibus minute pubescentibus, mox glabratis; foliis ternatis; petiolo 3–6 cm. longo, puberulo vel glabro, supra applanato; foliolis pedicellatis (pedicellis 6–15 mm. longis), chartaceis ad subcoriaceis, oblongo-ellipticis ad obovato-ellipticis, 6–12 cm. longis, 3–6 cm. latis, basi cuneatis, apice obtusis vel rotundatis, utrinque (maturis) glabris; venis primariis utrinsecus 10–14, manifestis (non prominulis), oblique adscendentibus, prope marginem arcuatim confluentibus; venulis reticulatis, leviter manifestis; paniculis axillaribus, praecipue ex axillis foliorum delapsorum ortis, usque 5 cm. longis latisque; axi superiore, ramulis pedicellisque fulvo-puberulis; pedicellis ± 5 mm. longis; sepalis ad basim connatis, 1.5 mm. longis, ovatis, obtusiusculis, utrinque puberulis; petalis 4 mm. longis, 2 mm. latis, apice inflexo-apiculatis, extus puberulis, intus basim versus minute pubescentibus; filamentis 6 mm. longis, intus basim versus pubescentibus; antheris 1.4 mm. longis; disco crasso.

tomentoso; carpellis 4, tomentosis; stylo 3 mm. longo, minute piloso; fructibus ignotis.

BRITISH NEW GUINEA: Western Division, Wassi Kussa River, Tarara, *Brass 8553* (TYPE), December 1936, in rain-forest (common canopy tree; bark soft, corky, deeply fissured; flowers pink); Oriomo River, Wuroi, *Brass 5851,* January–March 1934, alt. 1030 m., common in rain-forest and scattered occasionally on savannah (tree 25 m. high, with gray channelled bark; flowers dark pink to almost white, profusely flowering; nectar copious).

This species closely approaches the very sketchy description of *Evodia altissima* Baker f. It differs in having rounded or obtuse leaflets (not acuminate), panicles mostly below the leaves, flowers about the size of those on a specimen we have determined as *E. Forbesii* Baker f., and stamens finely pubescent toward the base of the inner face of the filament.

Evodia cladantha sp. nov.

Arbor 21 m. alta; ramulis ad apicem velutinis, angulatis, ad nodos valde compressis, interdum sulcatis; foliis ternatis; petiolo 9–11 cm. longo, supra applanato, velutino; foliolis sessilibus, chartaceo-coriaceis, ellipticis vel oblongo-ellipticis (terminali 18–25 cm. longo, 9–11 cm. lato; lateralibus 12.5–17.5 cm. longis, 7–9 cm. latis), basi rotundatis ad subcordatis, apice abrupte acuminatis (acumine ± 1 cm. longo) ac cuspidatis, supra fuscis, praecipue secus costam nervosque minute pubescentibus, subtus pallidioribus, subvelutinis; venis primariis utrinsecus 12–20, supra manifestis, subtus prominulis, oblique patentibus, prope marginem arcuatim anastomosantibus; venulis reticulatis, supra inconspicuis, subtus manifestis; paniculis lateralibus, e ramis circiter 1.5 cm. diametro ortis, ± 5.5 cm. longis, 6 cm. latis (pedunculo 1.5–2.5 cm. longo), multifloris; axi, ramulis pedicellisque tomentulosis; sepalis 1 mm. longis, subrotundatis, pubescentibus vel tomentulosis; petalis 5 mm. longis, 2 mm. latis, apice inflexo-apiculatis, intus basim versus minute pubescentibus, caetera glabris; staminibus glabris, filamentis 11 mm. longis, antheris 2 mm. longis; disco dense tomentoso, 1 mm. alto; ovario villoso; stylo 11 mm. longo, glabro; fructibus ignotis.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, *Brass & Versteegh 14003* (TYPE), April 1939, alt. 70 m., frequent tree in the primary forest of the flood-plain (21 m. high, 43 cm. diameter; bark 8 mm. thick, gray, rough, fissured; wood white; flowers rose).

Among the larger-flowered species of *Evodia,* this species is best characterized by the lateral inflorescences, the velutinous young branchlets, and the sessile leaflets with rounded bases, acuminate apices and the soft pubescence on the lower surface of the lamina.

Evodia eriophylla sp. nov.

Arbor 24 m. alta; ramulis apicem versus ± obtuse angulatis, ad nodos valde compressis, innovationibus fulvo-tomentosis, mox glabratis; foliis ternatis; petiolo 3–4 cm. longo, glabrato, supra applanato; foliolis brevissime pedicellatis (pedicellis 3–6 mm. longis, fulvo-tomentosis ad glabratis), crasse coriaceis, obovato-oblongis, 9–17 cm. longis, 4.5–6.5 cm. latis (in parte latissima), basi acute cuneatis, apice obtusis acumine brevissimo praeditis, supra glabris, subtus dense fulvo-tomentosis, costa venisque primariis supra impressis, subtus prominentibus; venis primariis utrinsecus 18–23, adscendentibus, ad marginem arcuatim confluentibus; venis reticulatis, utrinque submanifestis; paniculis axillaribus, usque 17 cm. longis, 14 cm. latis (pedunculis circiter 8 cm. longis); axi, ramulis pedicellisque minute tomentosis ad glabratis; pedicellis 3 mm. longis; sepalis vix 2 mm. longis, subrotundatis, puberulo-tomentosis; petalis anguste imbricatis, late ellipticis, 4 mm. longis, 2.5 mm. latis, apice inflexo-apiculatis, extus glabris, intus praecipue basim versus pilosis vel breviter villosis; staminibus glabris; filamentis 4 mm. longis, ad basim dilatatis; antheris 1.5 mm. longis, connectivo fusco; disco breviter villoso; ovario 4-partito, subgloboso, breviter villoso, 1 mm. alto; stylo 1.2 mm. longo, glabro; stigmate capitato, indistincte 4-lobato.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, *Brass & Versteegh 10459* (TYPE), October 1938, alt. ± 2850 m., rare in old secondary forest (tree 24 m. high, 37 cm. diameter; bark 5 mm. thick, soft brown; wood white; flowers white).

This species agrees with several features of the description of *Evodia pachypoda* Lauterb. Nevertheless, the leaflets of the latter are subsessile with a subrounded base, and the lower surface particularly on the nerves is tomentose (this statement would seem to indicate a difference in the amount of pubescence on the nerves and on the blade between), the sepals are acute, and the petals are densely villous within. In *E. eriophylla,* on the other hand, the leaflets are very short petiolulate with a distinctly cuneate or acute base, the lower surface of the leaf is covered with a fine close tomentum (this appears to be easily rubbed off the nerves, particularly the midrib), the sepals are rounded and the petals pilose or very short villous only on the lower part of the inner surface.

Evodia Elleryana F. v. Muell. var. **tetragona** (K. Sch.) W. D. Francis, Kew Bull. **1931:** 189.

SOLOMON ISLANDS: Malaita, Quoi-mon-apu, *Kajewski 2323,* December 1930, alt. 50 m., common in rain-forest; Ysabel, Tasia, *Brass*

3289, December 1932, common in lowland rain-forests (tree attaining 15 m.; bark pale pinkish gray; flowers pink, usually on branches below the leaves).

Previously reported from New Guinea and the Bismarck Archipelago.

Evodia cuneata sp. nov.

Arbor parva; ramulis (fragmento tantum viso) glabris; foliis ternatis; petiolo 9 cm. longo, glabro, supra applanato; foliolis subsessilibus, tenuiter coriaceis, obovatis, 14–24 cm. longis, 10–16 cm. latis (lateralibus paullo inaequilateralibus), basi cuneatis, apice rotundatis vel acumine brevissimo praeditis, utrinque glabris; venis primariis utrinsecus 10–13, supra impressis, subtus prominentibus, oblique adscendentibus, prope marginem arcuatim confluentibus vel curvatis et evanescentibus; venulis inconspicuis; paniculis axillaribus (ante anthesim tantum), circiter 13 cm. longis, multifloris; axi puberulo; ramulis pedicellisque dense puberulis; sepalis rotundatis (interdum acutiusculis), 1–1.5 mm. longis, puberulis; petalis 3.5 mm. longis, 2.5 mm. latis, extus glabris, intus dense breviterque villosis; staminibus glabris; disco dense pubescente; carpellis 4, dense pubescentibus; stylo glabro, 1.5 mm. longo; stigmate capitato, indistincte 4-lobato; fructibus ignotis.

Northeastern New Guinea: Ogeramnang, *Clemens 4895* (type), January 1937, alt. 1650 m., in forest (small tree with bright pink flowers).

This species is perhaps near *Evodia Bonwickii* F. v. Muell. and *E. pachypoda* Lauterb. It differs from both in the large glabrous obovate leaflets with rounded or almost apiculate apices.

Evodia Bonwickii F. v. Muell. Fragm. Phytogr. Austr. **5:** 56. 1865; F. M. Bail. Queensl. Fl. **1:** 200. 1899; C. T. White, Contr. Arnold Arb. **4:** 47. 1933.

British New Guinea: Lower Fly River, Sturt Island, *Brass 8159,* October 1936, plentiful in flood-plain rain-forest (very large, buttressed, canopy tree with thick hard shallowly fissured brown bark and coarse-grained pale wood; leaves stiff, nerves pale; fruit green, gland-dotted; seeds smooth, black).

Although we have no fruiting material with which to compare this collection (in full fruit), it seems to correspond reasonably well with a flowering specimen from the Atherton Tableland, Queensland. The remnants of petals found among the cocci are about the same size and have a villosity similar to those of the Australian material. It is to be noted that only the larger leaves of the Papuan plant (leaflets 8–17 cm.

long, 5–9.5 cm. broad) fall within the range of leaf-size given in the description of the Australian species. Possibly the leaflets of the Papuan collection are a little more coriaceous.

Evodia vitiflora F. v. Muell. Fragm. Phytogr. Austr. **7:** 144. 1871; F. M. Bail. Queensl. Fl. **1:** 201. 1899; C. T. White, Contr. Arnold Arb. **4:** 48. 1933.

BRITISH NEW GUINEA: Western Division, Upper Wassi Kussa River (left branch), *Brass 8635,* January 1937, in rain-forest (large canopy tree; bark gray, suberose, fissured; wood pale, aromatic; leaf-venation conspicuous on the upper surface; flowers white). Previously known from Australia.

Evodia phanerophlebia sp. nov.

Arbor parva, 6 m. alta; ramulis teretibus ad nodos leviter compressis, glabris, innovationibus stellato-puberulis; foliis ternatis; petiolo 4.5–9 cm. longo, glabro vel puberulo, supra ad apicem subcanaliculato; foliolis petiolulatis (petiolulis 0.5–1.2 cm. longis, canaliculatis, glabratis), chartaceis, subfalcato-oblongis vel obovato-oblongis, 7–13.5 cm. longis, 2.5–6 cm. latis (lateralibus paullo inaequilateralibus), basi acutis vel cuneatis, apice acuminatis (acumine usque 1.5 cm. longo), novellis parce puberulis, mox glabratis; venis primariis utrinsecus 8–12 oblique patenti-adscendentibus, prope marginem arcuatim conjunctis, supra leviter impressis, subtus prominentibus; venulis reticulatis, supra obscuris, subtus manifestis; paniculis axillaribus, usque 13 cm. longis, ramosis; axi, ramulis, bracteis, pedicellis calycibusque minute stellato-puberulis; pedicellis circiter 1 mm. longis; petalis 1.5 mm. longis, 0.8 mm. latis, glabris; staminibus brevissimis, 0.6 mm. longis; disco glabro; ovario distincte 4-partito, dense stellato-pubescente; stylo circiter 1 mm. longo, basim versus stellato-puberulo; stigmate 0.8 mm. lato, 4-lobato; coccis subglobosis, 3 mm. diametro, glabratis, minute pustulato-glandulosis.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass 12200* (TYPE), January 1939, alt. 1700 m., in rain-forest seral growths (small tree 6 m. high; leaf-nerves impressed above, prominent below; flowers white).

Evodia phanerophlebia shows some resemblance to *E. Bismarckii montium* Lauterb., but the leaflets are smaller, shorter petiolulate and practically glabrous; the panicles are axillary rather than terminal, and the disk of the flower is glabrous. In only one other specimen we have found a similar stigma with distinctly spreading lobes.

Evodia asteridula sp. nov.

Arbor circiter 8 m. alta; innovationibus, ramulis, petiolis, petiolulis, axi ramulisque inflorescentiae atque bracteis dense minuteque stellato-pilosis; ramulis teretibus, nodis compressis; foliis ternatis; petiolo 5.5–11 cm. longo, ad apicem canaliculato; foliolis subsessilibus (petiolulis 1–2 mm. longis), chartaceo-coriaceis, ellipticis (terminali 12–20 cm. longo, 6–11 cm. lato, lateralibus 8.5–16 cm. longis, 5–10.5 cm. latis), basi subrotundatis, apice breviter acuminatis (acumine 1–1.5 mm. longo); costa ac venis primariis supra parce, subtus ± dense minuteque stellato-pilosis; venis primariis utrinsecus 12–16, supra perspicuis, subtus prominulis, patentibus, prope marginem arcuatim conjunctis; venulis reticulatis, utrinque manifestis; paniculis axillaribus, circiter 15 cm. longis, ramosis, multifloris; floribus in ramulis brevibus confertis, breviter pedicellatis (pedicellis 0.5– vix 1 mm. longis, glabris); sepalis circiter 0.5 mm. longis, basi connatis, subrotundatis, ciliolatis; petalis glabris, 1.2 mm. longis, 0.6 mm. latis, apice inflexo-apiculatis; staminibus glabris, filamentis 1.5 mm. longis, antheris 0.5 mm. longis; disco glabro; ovario pubescente, 4-partito; stylo 1 mm. longo, glabro; fructibus ignotis.

Netherlands New Guinea: 4 km. southwest of Bernhard Camp, Idenburg River, *Brass 13282* (type), March 1939, alt. 850 m., in flood-plain rain-forest (tree 8 m. high; flowers white).

In some respects this species suggests *Evodia Radlkoferiana* Lauterb. It differs, however, in the elliptic leaflets, the minute stellate pubescence, and the very short petiolules. Among the collections examined, the dense but tiny crisp stellate hairs of *Evodia asteridula* give the species a distinctive appearance.

Evodia Radlkoferiana Lauterb. in K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee Nachtr. 281. 1905, Bot. Jahrb. **55:** 239. 1918.

Evodia lamprocarpa K. Schum. l.c. 280, 239 (fide Lauterb.).

Solomon Islands: Bougainville, Kupei Village, *Kajewski 1723,* April 1930, alt. 750 m., in rain-forest (tree up to 20 m. high, with minute cream flowers, and cocci in fours, threes, twos, and single, the latter 3 mm. long and 2 mm. diameter, seed shiny black); Malaita, Quoimonapu, *Kajewski 2361* (excluding fruit), December 1930, alt. 200 m., rain-forest on mountain (tree up to 20 m. high; buds only); Guadalcanal, Uulolo, Tutuve Mountain, *Kajewski 2516,* January 1931, alt. 1200 m., in rain-forest, common as a regrowth tree, also found in primeval forest (tree up to 15 m. high; flowers white).

Another collection, Bougainville, Kugumaru, Buin, *Kajewski 1832*, June 1930, alt. 150 m., in rain-forest (tree 15 m. high; flowers white, faintly scented), is more pubescent than the others and with slightly larger flowers; the fruit is less mature but a little more pubescent and compressed. We doubt that it is specifically different. All the collections fall within the range of the descriptions of *Evodia Radlkoferiana* Lauterb. Unfortunately we have no authentic material for comparison. The species has not previously been reported from outside New Guinea.

Evodia papuana sp. nov.

Arbor 6 m. et ultra alta; ramulis ad nodos leviter compressis, glabris, novellis puberulis vel minute pubescentibus; foliis ternatis; petiolo 3–8 cm. longo, glabro, supra applanato; foliolis petiolulatis (petiolulis ± 3 mm. longis, glabris), chartaceis vel subcoriaceis, lanceolatis ad ellipticis, 7–16 cm. longis, 2.5–5.5 cm. latis, basi acutis vel obtusis, apice acuminatis (acumine 0.5–1 cm. longo), utrinque glabris; venis primariis utrinsecus 11–14, oblique patentibus, prope marginem arcuatim anastomosantibus, manifestis; venulis reticulatis, subaequaliter manifestis; paniculis axillaribus ± 10 cm. longis, multifloris; axi, ramulis pedicellisque puberulis; pedicellis ± 1 mm. longis; sepalis ad medium connatis, 0.6 mm. longis, acutiusculis; petalis vix 2.5 mm. longis, apice inflexo-apiculatis, glabris; staminibus glabris; filamentis 2 mm. longis, antheris 1.2 mm. longis; disco glabro, vix 0.4 mm. alto; ovario puberulo, 4-partito; stylo 1 mm. longo, glabro.

BRITISH NEW GUINEA: Western Division, Upper Wassi Kussa River (left branch) *Brass 8646* (TYPE), January 1937, rain-forest substage (tree 6–7 m. high; leaves anise-scented; flowers white); Oriomo River, Wuroi, *Brass 5719*, January–March 1934, alt. 10 m., common in light rain-forest (slender small tree; leaves anise-scented; flowers white); Central Division, Ononge River, Dieni, *Brass 4004*, April–May 1933, alt. 500 m., rain-forest (loosely branched tree 12 m. high; bark brown, fissured; flowers white); Kubuna, *Brass 5579*, November 1933, alt. 100 m., common in forest on low ridges (tree 15–20 m. high; leaves dark, glossy, 3-foliolate; small white flowers).

Of the descriptions of New Guinea species of *Evodia*, the material cited above most closely approaches *E. anisodora* Lauterb. & K. Schum. The collections are relatively uniform and give no indication of the presence of single leaflets, the trifoliolate ones are consistently smaller (than those of *E. anisodora* Lauterb. & K. Schum.) and distinctly acuminate, the net-veining of the leaves is almost as manifest as the primary veins and the inflorescence is puberulous.

Evodia simulans sp. nov.

Arbor parva; ramulis teretibus, nodis leviter compressis, glabris; foliis ternatis; petiolo 3.5–6.5 cm. longo, glabro, supra applanato; foliolis subsessilibus (petiolulis 1.5–2.5 mm. longis, parce pilosulis), chartaceo-coriaceis, oblongo-ellipticis, 6–17 cm. longis, 2.5–6.5 cm. latis, basi obtuse cuneatis vel subrotundatis, apice acutis vel acuminatis, utrinque glabris; venis primariis utrinsecus 11–16, oblique patentibus, supra saepe impressis, subtus prominulis; venulis reticulatis, utrinque manifestis; paniculis axillaribus, 10–14 cm. longis, ramosis; axi, ramulis bracteisque substellato-puberulis; floribus in ramulis brevibus confertis, breviter pedicellatis (pedicellis vix 1 mm. longis, glabris); sepalis 0.4 mm. longis, ovatis, basi connatis, acutiusculis, fere glabris; petalis 1.4 mm. longis, ellipticis, apice inflexo-apiculatis, parce glandulosis; staminibus 2–2.5 mm. longis, filamentis glabris, subfiliformibus, antheris 1 mm. longis; disco glabro, parvo (0.2 mm. alto); ovario hirtello, inconspicue 4-partito, 0.5 mm. alto; stylo 0.8 mm. longo, glabro; fructibus non visis.

Northeastern New Guinea: Ogeramnang, *Clemens 6040* (type), *5412,* March and February 1937, alt. 1750 m.

Among the described New Guinea species of *Evodia,* this appears to be most like *E. Schraderi* Lauterb., but the leaflets have short petiolules, the petioles and the pedicels are glabrous, and the petals are sparsely glandular.

?Evodia Peekelii Lauterb. Bot. Jahrb. **55:** 227. 1918; Kaneh. & Hatus. Bot. Mag. Tokyo **52:** 409. 1938.

Solomon Islands: Bougainville Island, Karngu, Buin, *Kajewski 2281,* October 1930, rain-forest at sea-level; Kupei Gold Field, *Kajewski 1682,* April 1930, rain-forest, alt. 50 m.; Kieta, *Kajewski 1610,* March 1930, alt. 100 m.

The field notes indicate a common tree 15–20 m. high. *Kajewski 2281* is a fruiting specimen with capsule very shallowly 4-lobed; *Kajewski 1682* is in flower (♀), the four carpels are united, glabrous, and project above the disk; *Kajewski 1610* has a staminate inflorescence, the pistil is rudimentary and sunk in the centre of the disk. Known previously from the Bismarck Archipelago. Possibly this belongs to *Acronychia.*

Evodia solomonensis sp. nov.

Arbor usque 12 m. alta; ramulis novellis pubescentibus vel breviter tomentosis, mox glabratis; foliis trifoliolatis; petiolo 8–18 cm. longo, minute tomentoso ad glabrato; foliolis petiolulatis (petiolulis 3–6 mm.

longis, canaliculatis, minute tomentosis ad glabratis), chartaceis, minute pellucido-punctatis, ellipticis vel leviter obovato-ellipticis, 10–21 cm. longis, 6–11 cm. latis, basi cuneatis (lateralibus basi ± inaequalibus), apice breviter acuteque acuminatis (acumine ± 1 cm. longo), utrinque fere glabris, costa atque venis primariis subtus ± pubescentibus; venis primariis utrinsecus 10–16, oblique adscendentibus, ad marginem arcuatim confluentibus, supra manifestis, subtus prominulis; venulis reticulatis, inconspicuis; paniculis axillaribus (subterminalibus), usque 16 cm. longis, breviter tomentosis vel pubescentibus, multifloris, floribus in ramulis confertis; pedicellis brevissimis (0.5–1 mm. longis); calyce 1 mm. longo, ad medium lobato, puberulo-tomentoso, lobis rotundatis; petalis 2.2–2.4 mm. longis, 1.4 mm. latis, apice inflexo-apiculatis, glabris, extus minute consperseque glandulosis; staminibus 4, circiter 2.5 mm. longis; ♂ : disco crasso, lobato, glabro; carpellis liberis, minutis, glabris, in disco immersis; stylis connatis, brevissimis; ♀ disco angusto, glabro; carpellis fere ad medium connatis, glabris; stylis connatis, 2 mm. longis, glabris; stigmate capitato, 4-lobato; fructibus 3 mm. longis, 4 mm. latis; semine 1 mm. lato, 2 mm. longo, subellipsoideo.

SOLOMON ISLANDS: San Cristobal Island, Waimamura, *Brass 2682* (TYPE), August 1932, lowland rain-forests, common (tree 10 m. tall, not much branched; bark thin, brown, aromatic; leaves glabrous, shining; flowers green; fruit immature); Ysabel Island, Tiratona, *Brass 3209*, November 1932, alt. 600 m., mountain rain-forests, common (slender tree 12 m. tall, with close gray bark; leaves pale green, midrib very pale above; flowers cream-colored).

Evodia solomonensis appears to be closely related to *E. Peekelii* Lauterb. The carpels here, however, are only united half way to the apex. The leaflets too are short-petiolulate and cuneate rather than sessile and rounded at the base.

Evodia silvatica sp. nov.

Arbor gracilis; ramulis novellis velutinis; foliis trifoliolatis; petiolo 11 mm. longo, velutino; foliolis petiolulatis (petiolulis 5 mm. longis, subvelutinis, fere canaliculatis), chartaceis, minute pellucido-punctatis, ellipticis, circiter 21 cm. longis, 12 cm. latis, basi breviter cuneatis, apice obtusis, acumine brevissimo (3 mm. longo) praeditis, utrinque (costa supra ± pubescente, subtus tomentosa excepta) glabris; venis primariis utrinsecus ± 14, patenti-adscendentibus, ad marginem curvatis atque inconspicue anastomosantibus, utrinque perspicuis; venulis crebre reticulatis, supra inconspicuis, subtus manifestis; paniculis axillaribus (subterminalibus), 13–14 cm. longis (incl. pedunculo 8 cm. longo), ramulis

brevibus basi bracteis foliiformibus binis praeditis; axi, ramulis bracteisque velutinis; floribus in ramulis confertis; pedicellis circiter 1 mm. longis, minute pubescentibus; calyce ultra medium lobato, minute pubescente, lobis vix 1 mm. longis, triangularibus, acutiusculis; petalis 2.5 mm. longis, apice inflexo-apiculatis, glabris vel extus secus medium puberulis, minute glandulosis; staminibus 4, circiter 3 mm. longis, glabris, antheris 0.5 mm. longis; disco lato, applanato, extus glabro, intus barbato; carpellis minutis, in disco immersis; stylis liberis, brevissimis, glabris.

SOLOMON ISLANDS: Ysabel Island, Tataba, *Brass 3431* (TYPE), January 1933, alt. 30 m., rain-forests, common (slender second storey tree; leaves pale-nerved; flowers white).

Evodia silvatica is very much like *E. Peekelii* Lauterb. and *E. solomonensis*. It is to be distinguished from both by the velvety pubescence of the new growth, and the disk barbate or hirtellous within. This is probably a staminate inflorescence. The four minute glabrous styles do not protrude beyond the trichomes of the inner part of the disk; the concealed carpels are probably only rudimentary. The inflorescence is young, the bracts at the base of the branches are long and slender simulating a leaf, the lowest ones even have a short stalk.

The name *Evodia coriacea* Merr. Philip. Jour. Sci. **17**: 265. 1920, is invalidated by the earlier *E. coriacea* Lauterb. Bot. Jahrb. **55**: 237. 1918, and should be changed to **E. philippinensis** nom. nov.

Melicope Forst.

Melicope parvifolia sp. nov.

Arbor usque 8 m. alta; ramulis teretibus, novellis obtuse angulatis, in sicco rubescentibus, glabris; foliis unifoliolatis; petiolo 0.3–1 cm. longo, glabro, supra subcanaliculato; foliolo sessili, tenuiter coriaceo, oblongo ad late elliptico, 1–3.3 cm. longo, 0.8–2.2 cm. lato, basi obtuso, apice retuso vel subemarginato, utrinque glaberrimo, minute punctato; costa supra impressa, subtus prominula; venis primariis utrinsecus ± 6, patentibus, prope marginem arcuatim confluentibus, vix manifestis; inflorescentiis axillaribus, glabris, circiter 1 cm. longis, paucifloris (in specimine typico immaturis, 2-floris); pedicellis 2 mm. (fructiferis usque 5 mm.) longis; sepalis basim versus crassis ac connatis, circiter 1.2 mm. longis, exterioribus rotundatis, interioribus obtusiusculis, glabris; petalis . . . . ; staminibus 8, non fertilibus, vix 1 mm. longis; filamentis complanatis, membranaceis, ciliatis; antheris minutis vel nullis; disco an-

gusto, breviter pilosulo; ovario 4-partito, glabro; stylo vix 2 mm. longo, glabro; ovulis superpositis; fructibus 2–4 coccis; coccis liberis, minute glandulosis, compressis, consperse rugulosis, ellipsoideis, 6 mm. longis, 5 mm. latis, vix maturis.

BRITISH NEW GUINEA: Central Division, Mount Albert Edward, *Brass 4341* (TYPE), May–July 1933, alt. 3680 m., rare in forest (slender tree 4–5 m., branches erect; leaves dark, shining, citrus-like; flowers yellowish; fruit green); Mount Albert Edward, *Brass 4398*, May–July 1933, alt. 3680 m., common in forest (tree 5–8 m. high with straight trunk and ascending branches; leaves gland-dotted, somewhat yellowish beneath; flowers yellow-green; fruit immature). Unfortunately only a couple of flowers are left on the specimens and the petals have fallen from both. Apparently the flowers disarticulate very readily from the axis.

The glabrous character of the plant, the size, and the apparent lack of primary veins in the leaflets, suggest *Evodia aneura* Lauterb. Yet, having 8 stamens, our species surely belongs to *Melicope* Forst. Further *Evodia aneura* Lauterb. has trifoliolate leaves; these specimens have unifoliolate ones.

Melicope sterrophylla sp. nov.

Arbor parva, 3–4 m. alta; ramulis glabris, cinereis, novellis rubiginosis; foliis unifoliolatis; petiolo 0.7–1.2 cm. longo, supra subcanaliculato vel applanato; foliolo sessili, rigide coriaceo, crebre glanduloso-punctato, supra nitido, elliptico ad obovato, 5–8 cm. longo, 3–4 cm. lato, in basim cuneatum angustato, apice rotundato vel retuso, utrinque glaberrimo; costa subtus prominente; venis primariis utrinsecus 8–12 in utraque pagina subaequaliter manifestis, patentibus, fere transversis, in venam submarginalem confluentibus; venulis laxe reticulatis, supra manifestis, subtus leviter manifestis; inflorescentiis subterminalibus (ante anthesim tantum), ± 2 cm. longis, paucifloris (in specimine typico 2-floris), glabris; pedicellis 2 mm. longis; sepalis liberis, 2–3 mm. longis, 3–4 mm. latis, 2 exterioribus paullo brevioribus, margine subhyalinis, minute glandulosis; petalis valvatis, 5 mm. longis, lanceolatis vel ovatis, apice inflexo-apiculatis, minute glandulosis; staminibus 8, 4 brevioribus; filamentis subulatis, extus minute glandulosis, intus (basi glabra excepta) dense barbatis; antheris cordatis, 2–2.5 mm. longis, in staminibus brevioribus apiculatis; disco lobato in parte inferiore glabro, in parte superiore ± piloso-barbato; ovario glabro, 4-partito; stylo brevissimo (circiter 0.5 mm. longo), villoso; stigmate subgloboso, 4-lobato; fructibus ignotis.

BRITISH NEW GUINEA: Central Division, Wharton Range, Murray Pass, *Brass 4520* (TYPE), June–September, 1933, alt. 2840 m., in forest borders (small stiffly branched tree 3–4 m.; flowers yellow-green).

Melicope sterrophylla appears to be a very distinct species. We cannot suggest its alliance although the material seems to fall within the generic limits of *Melicope*. Its distinguishing characters are the very stiff leaves, the short and few-flowered subterminal inflorescences, the filaments bearded on the inner face, the large cordate anthers, the short villous style between the glabrous 4-carpelled ovary, and the large globose 4-lobed stigma.

Melicope polyadenia sp. nov.

Arbor usque 10 m. alta; ramulis subteretibus, glabris; innovationibus, ramulis novellis, petiolis foliolisque dense minuteque glanduloso-pustulatis, glabris; foliis unifoliolatis; petiolo circiter 2.4 cm. longo, supra subcanaliculato; foliolo sessili, subcoriaceo, obovato, 7–11.5 cm. longo, 4–5.5 cm. lato, basi cuneato, apice obtuso vel retuso; venis primariis utrinsecus 9–13, oblique patentibus, prope marginem arcuatim anastomosantibus, utrinque manifestis; costa subtus prominente; paniculis 2.5 cm. longis pedunculo 1 cm. longo incluso, glabris, pauci-ramosis, ramis brevissimis (2–3 mm. longis); pedicellis 2 mm. longis; sepalis 2 mm. longis, basim versus connatis, ovatis, acutiusculis, minute glandulosis; petalis 3.5 mm. longis, apice longiuscule inflexo-apiculatis, minute glandulosis; staminibus 8, non fertilibus; filamentis complanatis, longitudinem ovarii fere aequantibus, glabris; antheris minutis; disco vix manifesto; ovario 1.2 mm. longo, 4-partito, minute glanduloso; stylo 1 mm. longo, glabro, stigmate capitato, 4-lobulato; fructibus (uno tantum viso) 4-coccis; coccis dense minuteque glanduloso-pustulatis, oblique ovoideis, apiculatis; semine 4 mm. longo, 3 mm. lato, modice compresso.

BRITISH NEW GUINEA: Central Division, Mount Tafa, *Brass 4858* (TYPE), May–September 1933, alt. 2400 m., common in forests (small tree up to 10 m. high; midrib prominent beneath; flowers cream-colored; fruit dark green, seeds black).

This species, in its foliar character, is somewhat like *Melicope sarcococca* Lauterb. It has, however, a shorter panicle, the mericarp is not pedicellate, and the epicarp, although glandular, could scarcely be considered fleshy. The entire new growth is copiously glandular-pustulate. The flowers are probably unisexual, as the anthers are incompletely developed.

Melicope heterophylla sp. nov.

Arbor usque 12 m. alta, glabra; ramulis subteretibus, novellis minute glandulosis; foliis uni- atque tri-foliolatis; petiolo 2–5 cm. longo, canaliculato; foliolis brevissime petiolulatis (petiolulis 1–2 mm. longis), chartaceis vel tenuiter coriaceis, oblongo-ellipticis, 3–7.5 cm. longis, 1–3 cm. latis (lateralibus quam terminali saepe paullo brevioribus), basi obtusis vel cuneatis, apice retusis vel obtusis, utrinque glabris, crebre glanduloso-punctatis; costa supra impressa, subtus prominente; venis primariis utrinsecus 9–11, patentibus, prope marginem arcuatim confluentibus, inconspicuis vel vix manifestis; paniculis axillaribus, plerumque quam petiolo brevioribus, ramulis brevibus (usque 4 mm. longis), paucifloris; sepalis fere ad medium connatis, lobis ovatis, obtusiusculis, 1 mm. longis; ♂ : staminibus 8, filamentis 4 mm. longis, 4 paullo brevioribus, applanatis, glabris, antheris 1 mm. longis; ♀ : staminodiis 8, longitudinem ovarii fere aequantibus, glabris; disco glabro, 0.5 mm. alto; ovario subangulato, glabro; stylo 1 mm. longo; stigmate subgloboso-capitato; fructibus 1–4-coccis, coccis liberis basi connatis, minute pustulatis, subglobosis, 4 mm. diametro; semine 3 mm. diametro.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, *Brass 10296* (TYPE), October 1938, alt. 2800 m., seral growths in a small forest opening (tree 4 m. high; aromatic, flowers white); Bele River, 18 km. northeast of Lake Habbema, *Brass 11417,* November 1938, alt. 2200 m., in a small forest clearing (very slender tree 5 m. high; flowers white); Bele River, *Brass 11529,* November 1938, alt. 2400 m., occasional in forest substage (tree 12 m. high; flowers white).

Melicope heterophylla is perhaps allied to *M. alba* Lauterb., but the petioles are not winged, the leaflets are shorter petiolulate than those of the related species, and oblong-elliptic and retuse or obtuse at the apex, rather than lanceolate and obtusely subacuminate.

Melicope novo-guineensis Val. Bull. Dep. Agr. Ind. Neerl. **10:** 24. 1907, Ic. Bogor. **3:** 195, *t. 274.* 1908; Lauterb. Bot. Jahrb. **55:** 241. 1918, Nov. Guin. **14:** 141. 1924.

BRITISH NEW GUINEA: Palmer River, 2 miles below Black River Junction, *Brass 7078,* June 1936, alt. 100 m., common in undergrowth of ridge-forests (a small tree 3 m. high; flowers white). NETHERLANDS NEW GUINEA: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass 13027,* February 1939, alt. 1250 m., rain-forest undergrowth (slender tree 2.5 m. high).

One collection is in flower, the other in fruit; the first has 1-foliolate leaves, the second shows both 1-foliolate and 3-foliolate leaves. Lauter-

bach, in his key to the species of this genus, characterizes the leaves of this species as smooth. Valeton describes the veins on the lower surface as minutely hirsute. The species is very close to *M. papuana* Lauterb.

Melicope clathrata sp. nov.

Arbor 6–9 m. alta; ramulis novellis velutinis; foliis trifoliolatis; petiolo 3–9 cm. longo, velutino; foliolis petiolulatis (petiolulis 1–1.5 cm. longis, velutinis, supra subapplanatis), coriaceis, discoloribus, ellipticis vel obovato-ellipticis, 7–12(–19) cm. longis, 4–7(–10) cm. latis, basi cuneatis vel obtusis, apice obtusis vel ?apiculatis, supra glabris, in costa ± tomentosis, subtus parce tomentosis, in costa tomentosis; venis primariis utrinsecus 15(–18), oblique patentibus, subtus prominentibus, tomentosis; venulis supra inconspicuis, subtus clathrato-reticulatis; paniculis e ramis 8 mm. diametro ortis, multifloris (floribus non visis); fructibus dense confertis; sepalis ovatis, 1 mm. longis, tomentosis; petalis ovatis, acutis, 2 mm. longis, 1.5 mm. latis, extus tomentosis, intus glabris; staminibus 8, ?glabris; fructibus 1–4-coccis; coccis liberis, dense tomentosis, subglobosis, circiter 5 mm. longis, 4 mm. latis, vix compressis; endocarpio soluto; semine 3.5 mm. longo, 3 mm. lato.

Northeastern New Guinea: Morobe District, Ogeramnang, *Clemens 4713* (type), December 1936, alt. 1800 m., in forest with *Podocarpus* and *Dacrydium;* Yunzaing, *Clemens 4101,* September 1936, alt. 1500 m.

Although both these numbers are fragmentary specimens, we have not found any description of a species in which they might belong. Fortunately, upon scanning the fruits we found a few to which the petals and withered stamens were still attached. The description of the flowers of *M. trachycarpa* Lauterb. might fit these specimens, but surely the cocci in our species would not be considered rough, and the characterization of the leaves does not suit this material at all.

Melicope coriacea sp. nov.

Arbuscula 2–4 m. alta; ramulis glabratis, innovationibus tomentosis; foliis trifoliolatis; petiolo 3.5–4.5 cm. longo, minute tomentoso, supra canaliculato; foliolis petiolulatis (petiolulis 1.1–2 cm. longis, subapplanatis, minute tomentosis), coriaceis, discoloribus, ellipticis, 9–14 cm. longis, 5–7 cm. latis, basi obtusis atque leviter decurrentibus, apice acutiusculis (fere obtusis), supra glabris (costa interdum pubescente), subtus ± tomentosis; venis primariis utrinsecus 12–15, supra impressis, subtus perspicuis, patenti-curvatis, ad marginem arcuatim confluentibus; venulis laxe reticulatis, supra subobscuris, subtus manifestis; paniculis in axillis foliorum superiorum (subterminalibus), immaturis, tomentosis;

sepalis tomentosis, fere ad medium connatis, ovatis, circiter 1 mm. longis; petalis oblongis, 2.5 mm. longis, 1.5 mm. latis, utrinque minute tomentosis; staminibus 8, circiter 1 mm. longis; filamentis subulatis, glabris; fructibus 1–4-coccis; coccis basi cohaerentibus, minute tomentosis, subglobosis, apiculatis, ± 4 mm. diametro.

BRITISH NEW GUINEA: Central Division, Wharton Range, Murray Pass, *Brass 4574* (TYPE), June–September 1933, alt. 2840 m., shrubby forest borders (common small tree 2–4 m. with stiff erect branches; leaves pale; flowers and fruit green).

The inflorescences on this specimen show only very young buds. The description of the flower is compiled from the parts attached to the immature fruits.

We have noted two other species, *Melicope reticulata* Lauterb. and *M. perspicuinervia* with petals tomentose on both surfaces. In *M. coriacea* the trichomes on the lower surface of the leaf are not confined to the venation; the fruit is tomentose (not subrugose).

Melicope perspicuinervia sp. nov.

Ramuli tomentosi ad glabrati; foliis trifoliolatis; petiolo 7–11 cm. longo, minute tomentoso; foliolis petiolulatis (petiolulis 6–9 mm. longis, minute tomentosis), chartaceo-coriaceis, discoloribus, oblanceolatis ad oblongo-ellipticis, 14–21 cm. longis, 4.5–7.5 cm. latis (parte latissima ultra medium), basi anguste cuneatis, decurrentibus, apice breviter acuminatis (fere cuspidatis), supra (costa pubescente excepta) glabris, subtus secus costam venasque primarias tomentosis ad glabratis; venis primariis utrinsecus 9–12 patenti-curvatis, marginem versus arcuatim anastomosantibus, supra impressis, subtus perspicuis; venulis laxe reticulatis, subtus subprominulis; paniculis axillaribus ± 8 cm. longis, minute tomentosis, multifloris; floribus non visis; sepalis circiter 1.2 mm. longis, ovatis; petalis circiter 3 mm. longis, utrinque minute tomentosis; staminibus 8, glabris, vix 1 mm. longis; fructibus 1–4-coccis; coccis minute tomentosis, 5 mm. diametro, subapiculatis.

NORTHEASTERN NEW GUINEA: Morobe District, Sarawaket, *Clemens 5556, 5672* (TYPE), April 1937, alt. about 2700 m.

Melicope perspicuinervia is most closely related to *M. reticulata* Lauterb. The cocci of the former are densely short tomentose, and although apparently mature, show no suggestion of rugosity.

Melicope mucronata sp. nov.

Arbor usque 10 m. alta; ramulis ad nodos valde compressis, glabratis, innovationibus dense tomentosis; foliis trifoliolatis atque interdum

unifoliolatis; petiolo 6–17 cm. longo, tomentoso ad glabrato, supra canaliculato; foliolis subsessilibus (petiolulis 2–3 mm. longis, minute tomentosis) chartaceis vel tenuiter coriaceis, anguste ellipticis ad obovato-ellipticis, 9–23 cm. longis, 5–11 cm. latis (terminali quam lateralibus paullo majore), basi longe cuneatis, leviter decurrentibus, apice obtuse cuspidatis vel breviter acuminatis mucronatisque, crebre atro-punctatis supra costa pubescente excepta glabris, subtus secus costam venasque primarias tomentosis ad glabratis; venis primariis utrinsecus 13–18, oblique adscendentibus, marginem versus arcuatim anastomosantibus, supra manifestis, subtus perspicuis; venulis laxe reticulatis, subtus manifestis; paniculis axillaribus, usque 11 cm. longis, multifloris; axi, ramulis pedicellisque pubescentibus; sepalis 1.4 mm. longis, rotundatis, pubescentibus; petalis glabris, 2.5 mm. longis, vix 2 mm. latis, apice leviter inflexo-apiculatis; staminibus 8, ± 2 mm. longis, 4 paullo brevioribus, filamentis glabris, ad basim applanatis; antheris circiter 0.6 mm. longis; disco crasso, 0.5 mm. longo, glabro, sublobato; carpellis 4, minutis, glabris; stylis connatis, brevissimis (vix 0.5 mm. longis), glabris; fructibus 1–4-coccis; coccis liberis, subglobosis, apiculatis, 3–3.5 mm. diametro, glabris, subtransverse costulatis.

Netherlands New Guinea: 9 km. northeast of Lake Habbema, *Brass 10778* (type), October 1938, alt. 2750 m., common in secondary forest (tree attaining ± 10 m.; leaf-nerves impressed above, prominent below; flowers green); Bele River, 18 km. northeast of Lake Habbema, *Brass 11476*, occasional in secondary forest (tree 4 m. high).

In the large leaves with a long cuneate base, this plant suggests *Melicope grandifolia* B. L. Burtt of the Solomon Islands. The leaflets, however, are more nearly sessile, more pubescent, and more distinctly cuspidate in *M. mucronata*.

Melicope macrophylla sp. nov.

Arbuscula 3–5 m. alta; ramulis ad nodos compressis, innovationibus fulvo-pubescentibus; foliis trifoliolatis; petiolo 11–18 cm. longo, glabro; foliolis petiolulatis (petiolulis 2.3–3 cm. longis, supra subapplanatis, glabris), coriaceis, oblongis vel oblongo-ellipticis, 20–33 cm. longis, 8.5–13.5 cm. latis (terminali quam lateralibus paullo majore), basi cuneatis, apice rotundatis vel apiculatis, utrinque glabris, inconspicue glanduloso-punctulatis, supra olivaceo-viridescentibus, subtus brunnescentibus; costa subtus prominente; venis primariis utrinsecus 16–21, patentibus, marginem versus arcuatim anastomosantibus, subtus prominulis; venulis laxe reticulatis, subtus fere prominulis; paniculis axillaribus (novellis velutinis, pedicellis alabastrisque glabris), in fructu 19 cm. longis, multifloris; pedicellis ± 2 mm. longis; calyce fere ad

medium 4-lobato, lobis vix 1 mm. longis, ovatis, acutis; petalis glabris, in alabastro extus minute glandulosis; staminibus 8, 4 brevioribus; ovario 4-lobato, glabro; stylo glabro; stigmate minute 4-lobato; fructibus (probabiliter immaturis) 1–4-coccis; coccis basi cohaerentibus, vix 5 mm. longis, 4 mm. latis, compresse subglobosis, apiculatis, glandulosopustulatis.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, *Brass 11401* (TYPE), November 1938, alt. 2300 m., forest undergrowth, common in moist sheltered hollows (tree 3–5 m. high; flowers white — young buds only).

Melicope macrophylla, in some characters, approaches *M. iboensis* Lauterb., but in the former the petiolules are much longer, the upper and lower surfaces of the dried leaves are not the same color (this character of like color was emphasized by Lauterbach in the comment following the description of his species), the axis of the inflorescence is velutinous, but the pedicels are glabrous both on the very immature bud and on the fruit.

Melicope solomonensis sp. nov.

Arbor usque 15 m. alta; ramulis minute puberulis vel glabris; foliis trifoliolatis; petiolo 12 cm. longo, glabro; foliolis petiolulatis (petiolulis 5–10 cm. longis, glabris), chartaceis, minute consperseque pellucidopunctatis, fere opacis, oblongo-ellipticis, 15–40 cm. longis, 6–11 cm. latis, basi cuneatis (lateralibus basi inaequalibus), apice breviter acuminatis (acumine 5 mm. longo), utrinque glabris, subtus interdum costa venisque parce minuteque pubescentibus; venis primariis utrinsecus 12–20, oblique patentibus, ad marginem arcuatim confluentibus, manifestis; venulis laxe reticulatis, supra inconspicuis, subtus submanifestis; paniculis axillaribus, usque 19 cm. longis, multifloris; floribus subglomeratis; axi, ramulis pedicellisque minute pubescentibus; calyce 1 mm. longo ultra medium lobato, puberulo; petalis 2 mm. longis, 1 mm. latis, glabris; staminibus 8, glabris; disco crasso, lobato, glabro; carpellis 4, minutis; stylis connatis, brevissimis.

SOLOMON ISLANDS: Guadalcanal, Uulolo, Tutuve Mountain, *Kajewski 2511* (TYPE), April 1931, alt. 1200 m., common in rain-forest (tree up to 15 m. high; flowers white).

The species seems closely related to *Melicope grandifolia* B. L. Burtt; yet it differs in that the leaves are not densely pellucid-glandular, in outline they are oblong-elliptic rather than obovate-lanceolate, the reticulations are lax and inconspicuous, and the flowers are slightly smaller than in *M. grandifolia* B. L. Burtt.

Melicope pubifolia sp. nov.

Arbuscula 3 m. alta; innovationibus, petiolis, petiolulis, axi inflorescentiae ramulisque fulvo-tomentosis; foliis uni- atque tri-foliolatis; petiolo 1.5–3.5 cm. longo, subtereti; foliolis breviter petiolulatis (petiolulis 3–5 mm. longis), tenuiter coriaceis, ellipticis vel interdum leviter obovato-ellipticis (terminali usque 7–8 cm. longis, 4 cm. latis, lateralibus ± 4.5 cm. longis, 2.2 cm. latis), basi obtusis vel cuneatis, apice obtusis, paululo apiculatis, supra puberulis vel glabris, costa pubescente, subtus minute strigillosis, costa venisque primariis tomentulosis; venis primariis utrinsecus 8–10, patentibus, prope marginem arcuatim confluentibus, supra inconspicuis, subtus perspicuis; venulis reticulatis, subtus manifestis; paniculis circiter 7 cm. longis, gracilibus, parce ramosis, paucifloris; pedicellis circiter 3 mm. longis, minute pubescentibus; calyce fere ad medium 4-lobato, minute pubescente, lobis rotundatis, ± 0.6 mm. longis; petalis 2.2 mm. longis, 1.4 mm. latis, apice inflexo-apiculatis, glabris; staminibus glabris, 4 brevioribus; filamentis applanatis, antheris late ellipticis; disco glabro, sublobato; ovario 4-partito, glabro; stylo circiter 0.2 mm. longo; fructibus 1–4-coccis; coccis liberis, 5 mm. longis, 3.5 mm. latis, rotundatis, minute pustulatis, glabris, leviter rugulosis; semine circiter 4 mm. longo.

NETHERLANDS NEW GUINEA: 18 km. southwest of Bernhard Camp, Idenburg River, *Brass 12697* (TYPE), February 1939, alt. 2150 m., in mossy forest seral growths (tree 3 m. high; flowers white; fruit red).

The best characters of this species are the tawny pubescence, the shape of the leaflets, the prominent primary veins on their lower surface, and the slender sparsely branched inflorescences with few flowers.

Tetractomia Hooker f.

Tetractomia Hook. f. Fl. Brit. Ind. **1**: 490. 1875.

Terminthodia sensu Ridley, Trans. Linn. Soc. Bot. II. **9**: 24. 1916; Lauterb. Bot. Jahrb. **55**: 245. 1918, Nov. Guin. **14**: 142. 1924, Bot. Jahrb. **59**: 535. 1925; Engler, Nat. Pflanzenfam. ed. 2, **19a**: 230. 1931; vix Ridley 1915.

Glancing over the Rutaceae preparatory to studying the material of this family in the Papuan collections, we were impressed by the resemblance of specimens labelled *Tetractomia* Hook. f. to those we had accepted as *Terminthodia* Ridley. A further scrutiny of seven Malaysian species (among them *Tetractomia Roxburghii* Hook. f., one of the original species of the genus) failed to reveal any generic differences in the specimens at hand. A brief review of the literature shows that

(probably on account of the floral character: 8 stamens, 4 perfect, 4 imperfect) Engler, Nat. Pflanzenfam. **3**(4): 122. 1895, reduced Hooker's genus to a section of *Melicope* Forst. apparently overlooking the significant feature of the winged seeds. While the floral characters approximate those of *Melicope* Forster, it impresses us as illogical to place a group of rutaceous plants with winged seeds in a genus where the seeds are not at all winged. Lauterbach, Bot. Jahrb. **55**: 246. 1918, accepted Engler's disposition of *Tetractomia* Hook. f.; although, after describing *Terminthodia Schultzei Leonhardi,* he commented, "Die Gattung steht der Sektion *Tetractoma* (Hook. f.) Engl. von *Melicope* ausserordentlich nahe und unterschiedet sich von derselben nur durch die geflügelten Samen." But even if no authentic fruiting material was available for examination, it is to be noted that both the description and the plate of *Tetractomia Roxburghii* Hook. f. Ic. **16**: *t. 1512.* 1886, clearly delineate the character of the winged seeds. Ridley, on the other hand, allied the genus *Terminthodia* to *Evodia,* also because of the number of stamens (4 perfect, none imperfect); the differential character was the winged seed of the former. When describing *Terminthodia oppositifolia,* from New Guinea, however, he enlarged the concept of his genus to include a plant with flowers having "4 staminodes alternating with the stamens each consisting of a short filament adnate to the petal and an abortive triangular anther." By this modified interpretation of the genus it then corresponded to the characters of the much older *Tetractomia* Hook. f.; hence, at least as to the Papuan species, the genus *Terminthodia* Ridley is not tenable. We have seen no material representing the Malay Peninsula *Terminthodia viridiflora* Ridl. which typifies the genus as Ridley originally characterized it.

Tetractomia oppositifolia (Ridl.) comb. nov.
Terminthodia oppositifolia Ridl. Trans. Linn. Soc. Bot. II. **9**: 24. 1916.

Tetractomia rotundifolia (Ridl.) comb. nov.
Terminthodia rotundifolia Ridl. in Gibbs, Contr. Phytog. Fl. Arfak Mts. 143. 1917.

Tetractomia Schultzei Leonhardi (Lauterb.) comb. nov.
Terminthodia Schultzei Leonhardi Lauterb. Bot. Jahrb. **55**: 245. 1918.

Tetractomia Treubiana (Lauterb.) comb. nov.
Terminthodia Treubiana Lauterb. Nov. Guin. **14**: 142. 1924.

Tetractomia orbiculata (Markgraf) comb. nov.
Terminthodia orbiculata Markgraf, Nov. Guin. **14**: 143. 1924.

Tetractomia lanceolata (Lauterb.) comb. nov.
Terminthodia lanceolata Lauterb. Bot. Jahrb. **59**: 535. 1925.

Tetractomia Lauterbachiana nom. nov.

Terminthodia obovata Lauterb. Bot. Jahrb. **55**: 246. 1918.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11197*, January 1939, alt. 1780 m., frequent in primary forest (tree 25 m. high, 45 cm. diameter; bark gray-brown, fairly rough; wood light yellow; flowers rose; fruit greenish brown); *Brass 12016, 12134, 12172*, January 1939, alt. 1800 m. and 1950 m., subsidiary tree in mossy forest.

The specific epithet *obovata* is already pre-empted in the genus *Tetractomia*.

Tetractomia Lauterbachiana forma **pumila** forma nova.

A typo recedit foliis minoribus (3–5 cm. longis, 2–2.5 cm. latis), petiolis circiter 8 mm. longis, floribus paucioribus.

NETHERLANDS NEW GUINEA: 18 km. southwest of Bernhard Camp, Idenburg River, *Brass 12454* (TYPE), *12192*, February and January 1939, alt. 2150 and 2100 m., mossy forest, common in open parts of the forest and abundant in low scrub on an exposed summit (tree 2–4 m. high; leaves concave with recurved margins; flowers red).

The general habit of these collections is so like that of *Tetractomia Lauterbachiana* that we take them to be a form of the species occurring in exposed places at high altitudes. The leaflets are much smaller with shorter petioles and there are fewer flowers in the inflorescence.

In addition to the above species which we are reasonably sure (from their descriptions) belong to *Tetractomia* Hook. f., Lauterbach, Nov. Guin. **14**: 142. 1924, has suggested another, *Melicope* (*Tetractoma*) *Lamii* Lauterb., based on a flowering specimen. We merely point out that the superficial generic characters of the flowers are so alike that it is practically necessary to know the position of a young seed in the locule, to determine whether the species belongs to *Melicope* Forst. or to *Tetractomia* Hook. f. Those of the former genus show axile placentation, those of the latter are basally located.

Acronychia Forst.

Acronychia rhytidocarpa sp. nov.

Arbor 4–5 m. alta; ramulis glabratis, innovationibus velutino-tomentosis; foliis trifoliolatis; petiolo 4–9.5 cm. longo, tomentoso ad glabrato; foliolis petiolulatis (petiolulis ± 7 mm. longis, minute pubescentibus), chartaceis, pellucido-punctatis, oblongo-ellipticis, basi acutis vel cuneatis, in petiolulum decurrentibus, apice breviter atque obtusissime

acuminatis, utrinque glabris, interdum costa pubescentibus; venis primariis utrinsecus 11–16, patenti-adscendentibus, marginem versus curvatis, inconspicue anastomosantibus; venulis laxe reticulatis, inconspicuis; inflorescentiis axillaribus praecipue in axillis foliorum delapsorum, 4–6 cm. longis; axi, ramulis pedicellisque minute denseque tomentosis; pedicellis fructiferis 4 mm. longis; floribus non visis; calyce breviter lobato, pubescente; petalis extus minute pubescentibus, intus ad basim pubescentibus; staminibus intus ad basim ?pilosis; fructibus apertis circiter 1.5 cm. diametro; exocarpio glanduloso, extus dense transverse rugoso.

BRITISH NEW GUINEA: Central Division, Laloki River, Rona, *Brass 3566* (TYPE), March 1933, alt. 450 m., gully rain-forests, common (small tree 4–5 m. tall, with rather rough brown bark, and pale somewhat fleshy leaves; fruit rugose, yellow green, very glandular and secreting in the rind a yellowish viscid substance with a pungent odor).

This collection has previously been associated with *Acronychia melicopoides* F. v. Muell. Although the foliage is somewhat like that of the species mentioned, the fruits of the two are unlike. That of the Australian plant has a thicker pericarp and lacks the copious glandular secretion which is an outstanding feature of the fruit of the Papuan species.

Acronychia elliptica sp. nov.

Arbor usque 15 m. alta; ramulis subteretibus, innovationibus minute pubescentibus, mox glabratis; foliis unifoliolatis; petiolo 1.5–4 cm. longo, puberulo, mox glabro; foliolo sessili, chartaceo, elliptico, 9–14 cm. longo, 4–7 cm. lato, basi cuneato, apice obtuso vel retuso, utrinque glabro, subtus minute atro-punctato; venis primariis utrinsecus ± 14, oblique patentibus, marginem versus arcuatim anastomosantibus; venulis numerosis, reticulatis, utrinque manifestis; paniculis axillaribus, 3–4.5 cm. longis; axi, ramulis pedicellisque puberulis; sepalis rotundatis, vix 1 mm. longis, puberulis; petalis 5 mm. longis, 1–1.5 mm. latis, glabris, ad basim ciliatis; staminibus 8, filamentis subulatis, basim versus dilatatis, fere ad medium dense hirsutis (pilis retrorsis), basi intus glabris; antheris ellipticis, 0.5 mm. longis; disco 0.5 mm. alto, glabro; ovario circiter 2 mm. longo, villoso; stylo 2 mm. longo, basi tantum parce villoso; stigmate vix incrassato, 4-lobulato.

BRITISH NEW GUINEA: Western Division, Daru Island, *Brass 6309* (TYPE), March 1936, common in light rain-forest (tree about 15 m. high; bark brown, slightly fissured; flowers white; fruit not seen); Upper Wassi Kussa River (left branch), *Brass 8643,* January 1937, gallery

rain-forests (common small tree 3–4 m. high; leaf-nerves pale and conspicuous above; flowers green).

The plant superficially resembles *Acronychia laevis* Forst., but it is readily distinguished from the latter by the villous ovary. In the latter character it is like the Malaysian *A. pedunculata* (L.) Miq., yet differs in the glabrous petals and disk; the inflorescence is also much shorter.

Acronychia goniocarpa sp. nov.

Arbor magna, 25 m. alta, cauli 25–40 cm. diametro; ramulis glabris, in sicco nigrescentibus, innovationibus puberulis; foliis uni- atque trifoliolatis; petiolo 3–6 cm. longo, glabro vel puberulo; foliolis petiolulatis (petiolulis 1–1.5 cm. longis), subcoriaceis, minute glanduloso-punctulatis, oblongo-ellipticis, 10–20 cm. longis, 4.5–7 cm. latis, basi subrotundato-cuneatis (lateralibus basi inaequalibus), brevissime obtuseque acuminatis vel obtusis, utrinque glaberrimis; venis primariis utrinsecus 14–18, patenti-curvatis, marginem versus arcuatim anastomosantibus, in utraque pagina subaequaliter manifestis; venulis numerosis, reticulatis, manifestis; inflorescentiis axillaribus, saepissime ex axillis foliorum delapsorum, ± 9 cm. longis pedunculo 3–4 cm. longo incluso, glabris; floribus non visis; sepalis 1 mm. longis, 2 mm. latis, ad medium connatis; disco annulari, glabro; filamentis glabris; fructibus glabris, minute glandulosis, 1.3–1.5 mm. longis, angulatis, obpyriformibus, apiculatis (stylo basi subhirtello), pericarpio in sicco irregulariter lacunoso-fissurato.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11926, Brass 12093* (TYPE), January 1939, alt. 1780 m. and 1750 m., rain-forest of upper slopes (large canopy tree 25 m. high, 25 cm. stem-diameter [other collection 41 cm.], branchlets, petioles, and peduncles covered with a pale glaucous bloom; fruit yellow, deeply rugose).

The fruit of *Acronychia goniocarpa* somewhat resembles that of *A. acidula* F. v. Muell. but the epicarp is irregularly torn in drying. The latter species has only unifoliolate leaves.

Acronychia melicopoides F. v. Muell. Fragm. Phytogr. Austr. **5:** 3. 1865; F. M. Bail. Queensl. Fl. **1:** 209. 1899; Lauterb. Bot. Jahrb. **55:** 251. 1918, Nov. Guin. **14:** 144. 1924; C. T. White Contr. Arnold Arb. **4:** 50. 1933.

NETHERLANDS NEW GUINEA: Hollandia, *Brass 8955,* July 1938, alt. 20 m., rare in dry open rain-forest second growth (tree 3 m. high).

This species has already been reported by Lauterbach from Humboldt Bay. We merely add that the material cited above agrees precisely

with the Australian collections in both flower and fruit characters. The leaves of the New Guinea specimens are smaller and somewhat more glandular, the obtusely acuminate apex is distinctly recurved, and the base is acutely cuneate, usually a little narrower than in the Australian specimens.

Acronychia Pullei Lauterb. Bot. Jahrb. **55:** 250, 251. 1918, Nov. Guin. **14:** 144. 1924.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11951, Brass 12044,* January 1939, alt. 1900 m. and 1800 m., in mossy forest on slopes (tree 6–25 m. high; fruit yellow, rugose). NORTHEASTERN NEW GUINEA: Busu River, *Clemens 6274,* May 1937, alt. 1800–2400 m. BRITISH NEW GUINEA: Central Division, Mount Tafa, *Brass 4883,* May–September 1933, alt. 2400 m., in forest regrowths (small tree with pale dull leaves and numerous white flowers).

The dried fruit is small, 5–6 mm. diameter, subglobose, flattened at the base, copiously dotted with minute glands, and roughened by irregular short clefts in the apparently fleshy pericarp. The species was described from a flowering specimen.

Acronychia trifoliolata Zoll. & Mor. in Zoll. Nat. Geneesk. Arch. Neerl. Ind. **2:** 585. 1845; Koord. & Val. Meded. Lands Plant. **17:** 236 (Bijdr. Boomsoort. Java **4:** 326). 1896 (as *trifoliata*).

SOLOMON ISLANDS: Guadalcanal, Sorvorhio Basin, *Kajewski 2699,* January 1932, alt. about 270 m., common in rain-forest (tree ± 22 m. high, with light gray bark, cream-colored flowers, and small yellow-green fruits citron-scented when crushed, 7 mm. long, 5 mm. diameter).

The collection compares favorably with the material from Java assigned to this species.

Acronychia Muelleri (Engler) W. D. Francis, Kew Bull. **1931:** 190. 1931 and *A. cauliflora* Lauterb. ought to be compared. We suspect that the latter species, Bot. Jahrb. **55:** 253, *f. 5.* 1918, is identical with the former which holds the right of priority in name. We do not care to make the reduction without the opportunity of examining the types.

Acronychia anomala Lauterb. Nov. Guin. **14:** 145. 1924, cannot possibly be an *Acronychia* according to the accepted generic concept. We have no specimen which fits the description, so we leave its proper disposition to others. It may prove to be an *Evodia.*

Flindersia R. Br.

Flindersia Schottiana F. v. Muell. Fragm. Phytogr. Austr. **3:** 25. 1862; F. M. Bail. Queensl. Fl. **1:** 241. 1899; Maiden, For. Fl. N. S. W.

2: 155. *t. 69, 70.* 1905; C. T. White, Proc. Linn. Soc. N. S. W. **46:** 327. 1921.

British New Guinea: Lower Fly River, east bank opposite Sturt Island, *Brass 7991,* October 1936, rain-forest, common on ridges (large canopy tree; stem spur-buttressed; bark pale brown-gray, with prominent corky lenticels; wood soft, white; leaves pale below; flowers white, sweet-scented). Previously known from Australia.

Flindersia chrysantha sp. nov.

Arbor ± 23 m. alta; ramulis fuscis, lenticellatis, novellis puberulis; foliis oppositis vel suboppositis, pari- ac impari-pinnatis, 2–3-jugis; petiolo 3–4.5 cm. longo et rhachi 2.5–4.5 cm. longa glabratis; foliolis oppositis vel suboppositis, coriaceis, 6–10 cm. longis, 2–3.5 cm. latis, late lanceolatis vel falcato-oblongis, inaequilateralibus (vel terminali subaequilaterali), basi ± rotundatis, apice acuminatis (acumine ± 1 cm. longo), petiolulatis (petiolulis ± 6 mm. longis), utrinque glabris, margine integris; costa subtus prominente; venis primariis utrinsecus 10–13, manifestis; paniculis amplis; axi, ramulis pedicellisque dense puberulis vel brevissime pubescentibus; floribus flavis; sepalis 1 mm. longis, ovatis, obtusis, glabratis, ciliolatis; petalis ellipticis, 3 mm. longis, obtusis, glabris; filamentis 2 mm. longis, prope apicem parce pilosis, antheris ovoideis cordatis, apiculatis; staminodiis longitudinem filamentorum fere aequantibus, applanatis; disco membranaceo, undulato, glabro; ovario dense pubescente, 5-loculari, stylo brevissimo (0.4 mm. longo), stigmate depresse capitato-lobato.

Netherlands New Guinea: Bele River, 18 km. northeast of Lake Habbema, *Brass & Versteegh 11128* (type), November 1938, alt. ± 2300 m., frequent tree of old secondary forest (23 m. high, 30 cm. diameter; bark 5 mm. thick, brown, smooth; flowers yellow).

Flindersia chrysantha belongs in the same sequence with *F. laevicarpa* C. T. White, *F. Pimenteliana* F. v. Muell. and *F. Oxleyana* F. v. Muell. It seems most like the first, but the specimens are not in comparable stages of development (one flowering, one fruiting). In *F. laevicarpa* C. T. White the leaves are decurrent at the base (in *F. Oxleyana* they are narrowed at the base), and the branches of the panicle are glabrous or very thinly puberulent. The flowers of *F. Pimenteliana* F. v. Muell. are red, and the petals are pubescent outside.

Arnold Arboretum,
Harvard University.

STUDIES OF PAPUASIAN PLANTS, I*

A. C. SMITH

A SERIES of papers, of which this is the first, is planned to discuss certain groups of plants represented by the accumulated material in the herbarium of the Arnold Arboretum from New Guinea and the Solomon Islands. The larger part of the New Guinea specimens has been obtained by Mr. L. J. Brass, botanist of the Richard Archbold Expeditions, while the material from the Solomon Islands was chiefly collected by Mr. Brass and Mr. S. F. Kajewski. This series is expected to be supplementary to that of Drs. E. D. Merrill and L. M. Perry, Plantae Papuanae Archboldianae, now appearing in the Journal of the Arnold Arboretum.

All specimens cited in this series, unless otherwise mentioned, are deposited in the herbarium of the Arnold Arboretum.

MYRISTICACEAE

Since Dr. F. Markgraf (Bot. Jahrb. **67**: 143–170. 1935) has recently and ably summarized the Papuan species of Myristicaceae, no attempt is here made to discuss all of the recently collected specimens or to revise the group. The present treatment is limited merely to a discussion of range-extensions or specimens of unusual interest and to descriptions of 16 species which appear to be new. The order of treatment essentially follows that adopted by Markgraf. For the purposes of this study I have examined specimens deposited in the following herbaria: Arnold Arboretum (A), New York Botanical Garden (NY), U. S. National Herbarium (US), and Yale School of Forestry (Y); I am indebted to the Directors and Curators of these institutions for the privilege of borrowing material. The place of deposit of specimens is shown by the indicated letters in parentheses; when no place of deposit is shown, the specimen has been seen only in the herbarium of the Arnold Arboretum.

HORSFIELDIA Willd.

Horsfieldia trifida sp. nov.

Arbor ad 26 m. alta ubique praeter inflorescentiam et ramulos novellos inconspicue ferrugineo-puberulos glabra, cortice crassa nigrescente,

*Botanical Results of the Richard Archbold Expeditions.

trunco ad 60 cm. diametro, ramulis subteretibus; petiolis gracilibus leviter canaliculatis 11–17 mm. longis; laminis papyraceis vel chartaceis anguste oblongis, 22–28 cm. longis, 5.5–7 cm. latis, basi plerumque rotundatis interdum obtusis, apice cuspidatis vel breviter acuminatis (apice ipso obtuso ad 4 mm. longo), margine leviter reflexis, costa supra subplana vel leviter elevata subtus prominente, nervis secundariis utrinsecus 17–22 patentibus leviter arcuatis marginem versus manifeste anastomosantibus supra subplanis subtus valde prominulis, venulis laxe reticulatis utrinque immersis vel subtus prominulis; inflorescentiis ♂ laxiuscule paniculatis 7–11 cm. longis et latis, pedunculo brevi (ad 5 mm. longo) 1.5–2 mm. diametro, ramulis paucis patentibus, floribus 5–8 in fasciculos aggregatis, bracteis minutis mox deciduis; pedicellis ad 2 mm. longis cum basi perianthii arcte ferrugineo-tomentellis (pilis minutis ramosis demum caducis); perianthio obovoideo sub anthesi 1.5–2 mm. longo fere ad basim plerumque tripartito, lobis 3 (raro 4) deltoideis subacutis; filamentis in columnam clavatam 0.2–0.5 mm. longam connatis, antheris plerumque 14, 0.5–0.6 mm. longis, columnae dorso adnatis fere ad apices connatis; inflorescentiis ♀ et fructibus desideratis.

Netherlands New Guinea: Bernhard Camp, Idenburg River, *Brass & Versteegh 14017* (type), April 25, 1939, alt. 75 m., in rain-forest on lower mountain slope (rare tree with red-brown wood and a small amount of red latex). Northeastern New Guinea: Minjem-Gebiet, Kani-Gebirges, *Schlechter 17171* (A, NY), alt. 800 m.

This is doubtless the species which Markgraf (Bot. Jahrb. **67**: 148. 1935) referred to *H. oblongata* Merr., a Philippine species which probably does not occur in New Guinea. Compared with the new species, *H. oblongata* has the leaf-blades smaller (11–20 cm. long), somewhat elliptic and with the margins distinctly not parallel, the leaf-base acute or subacute but never rounded, the secondaries fewer (9–11), and the anastomoses fainter and farther from the margins. *Schlechter 17171* was cited by Markgraf, but I have not seen the other specimens mentioned by him, nor those which Pulle (Nova Guinea Bot. **8**: 636. 1912) referred to *H. costulata* (Miq.) Warb. and *H. leptocarpa* Warb. Possibly all of these specimens represent *H. trifida*, the closest relative of which appears to be (as indicated by Markgraf) *H. sepikensis* Markgraf. *Horsfieldia trifida* differs from this in its larger leaf-blades, rounded leaf-base, numerous secondaries, more ample ♂ inflorescence, short pedicels, and obvious androecium-stalk.

Horsfieldia Hellwigii (Warb.) Warb. Nova Acta Acad. Leop.-Carol. **68**: 343. 1897; Warb. in K. Schum. & Lauterb. Fl. Deutsch. Schutzg. Südsee 325. 1901; Markgraf, Bot. Jahrb. **67**: 150. 1935.

NORTHEASTERN NEW GUINEA: Morobe District, Wareo, *Clemens 1838*, alt. about 550 m.

This species has previously been known from three specimens from the same general region as the above. Although I have seen none of these, the Clemens specimen seems to match Warburg's description in vegetative details and to key to the species according to Markgraf. The leaf-blades of the present specimen are up to 11.5 cm. broad, somewhat broader than those previously described. As the Clemens specimen bears the first staminate inflorescence known for the species, this is described below. The pistillate inflorescence is notably shorter, according to Warburg, but this condition is to be expected in the group and does not necessarily indicate that a different species is represented. However, the Clemens specimen should be checked against the type before it is definitely taken to represent the species.

Staminate inflorescences densely brown-tomentose on all exterior surfaces (except flowers) with irregularly and copiously branched hairs, loosely paniculate, up to 10 cm. long and 6 cm. broad, the peduncle short (up to 1 cm. long), stout (about 3 mm. in diameter), the branches spreading; flowers in loose fascicles of 2–4, the bracts minute, evanescent, the pedicels slender, 2–4 mm. long; perianth subglobose, about 3 mm. in diameter, 2-lobed nearly to base; androecium-stalk stout, very short, the anthers about 14, about 1.5 mm. long, laterally connate to apex.

Horsfieldia tuberculata (K. Schum.) Warb. Nova Acta Acad. Leop.-Carol. **68**: 279, *pl. 23*. 1897; Markgraf, Bot. Jahrb. **67**: 151. 1935.

SOLOMON ISLANDS: Bougainville: Siwai, *Waterhouse 178* (A, Y) (jungle tree; common names: *Kagkag, Aiqil, Tutupun*). Teop, northeast of Bougainville: *Waterhouse 35* (Y) (small tree about 6 m. high, the trunk about 12 cm. diam.; common name: *Vadovodovuru*).

Although the cited specimens have flowers slightly larger than usual for the species, they appear to fall into a reasonable concept of it. *Horsfieldia tuberculata* has not previously been reported east of New Ireland (Neu Mecklenburg).

Horsfieldia novo-guineensis Warb. Nova Acta Acad. Leop.-Carol. **68**: 271. 1897; Warb. in K. Schum. & Lauterb. Fl. Deutsch. Schutzg. Südsee 323. 1901; Pulle, Nova Guinea Bot. **8**: 635. 1912; Markgraf, Bot. Jahrb. **67**: 151. 1935.

SOLOMON ISLANDS: Bougainville: Koniguru, *Kajewski 2022*, alt. 850 m. (common name: *Kisu-kisu*). Ysabel: Sigana, *Brass 3460*. Guadalcanal: Berande, *Kajewski 2444* (common name: *Ni-niu*); Uulolo, Tutuve Mt., *Kajewski 2554*, alt. 1200 m.; Sorvorhio

basin, *Kajewski 2710,* alt. 200 m. (common name: *Korvai*). San Cristoval: Huro R., *Brass 2605* (common name: *Do-do*). Both collectors mention the tree as common in rain-forest.

Although this species has been reported from many collections in New Guinea, these are apparently the first from the Solomon Islands.

Horsfieldia solomonensis sp. nov.

Arbor 10–20 m. alta ubique praeter inflorescentiae ramulos interdum arcte ferrugineo-tomentellos et partes novellas saepe puberulas glabra, cortice brunnea rimosa; ramulis subteretibus vel apicem versus leviter complanatis; petiolis anguste alatis 8–17 mm. longis circiter 2 mm. diametro; laminis papyraceis vel chartaceis siccitate umbrinis amplis elliptico-oblongis plerumque manifeste obovatis, 20–32 cm. longis, (5–) 7–15 cm. latis, basi obtusis vel subrotundatis et in petiolum decurrentibus, apice abrupte cuspidatis, margine planis vel leviter reflexis, costa lata supra subplana subtus prominente, nervis secundariis utrinsecus 13–18 patentibus marginem versus leviter arcuatis et inconspicue anastomosantibus supra subplanis vel leviter impressis subtus prominulis, venulis inconspicue et laxe reticulatis utrinque subplanis vel leviter prominulis; inflorescentiis ♂ multifloris laxe paniculatis, 6–13 cm. longis, 3–6 cm. latis, pedunculo ad 1 cm. longo et rhachi saepe flexuosa 1.5–2 mm. diametro, ramulis patentibus, floribus 4–10 in fasciculos apices ramulorum versus laxe aggregatis, bracteis mox caducis; pedicellis robustis 1.5–3 mm. longis; perianthio subgloboso vel transverse ellipsoideo valde complanato sub anthesi circiter 2 mm. longo et 2–3 mm. lato fere ad basim bilobato, lobis rotundatis; filamentis in columnam crassam sed brevissimam et inconspicuam connatis, antheris 15–21, circiter 1.5 mm. longis, columnae crassae dorso adnatis, ad apices connatis; inflorescentiis ♀ brevioribus (ad 5 cm. longis et 4 cm. latis), minus ramosis; floribus 2 vel 3 in fasciculos laxos aggregatis, pedicellis crassis ad 2 mm. longis; perianthio crasso obovoideo, 3–4 mm. longo, 2–3 mm. lato, profunde bilobato; ovario obovoideo, stigmate conspicue sulcato; fructibus maturitate ellipsoideis leviter verrucosis bicostatis ad 25 mm. longis et 15 mm. latis (ad 35 × 23 mm. ex Brass), pericarpio tenui siccitate 0.5–1 mm. crasso, arillo sicco fulvo, semine ellipsoideo, testa levi siccitate cinerea.

Solomon Islands: Bougainville: Kieta, *Kajewski 1549* (type), March 18, 1930 (tall tree to 20 m. high). Guadalcanal: Berande, *Kajewski 2440* (medium-sized tree to 10 m. high; common name: *Tarle;* bark macerated in water and the solution drunk to check haemorrhages). Ulawa: *Brass 2983* (excurrent tree 15 m. high, the

bark brown, fissured; flowers yellow; fruits to 3.5 cm. long and 2.3 cm. broad, obscurely 4-angled; common name: *Totonio*). The tree is said to be common in rain-forest at low altitudes. Pistillate inflorescences and fruits are described from *Brass 2983*, the other specimens bearing staminate inflorescences.

Horsfieldia solomonensis is characterized by its large thin leaf-blades with the greatest breadth usually above the middle. Its closest relative is probably *H. novo-guineensis* Warb., with narrower leaf-blades, somewhat less congested staminate flowers, fewer anthers, and smaller fruits.

Horsfieldia pachycarpa sp. nov.

Arbor compacta ad 10 m. alta ubique sub fructu glabra, ramulis crassis (apices versus 3.5–5 mm. diametro) fuscis leviter biangulatis parce lenticellatis; petiolis crassis (2.5–3 mm. diametro) conspicue canaliculatis 4–6 mm. longis; laminis subcoriaceis vel chartaceis elliptico-obovatis, 17–21 cm. longis, 6–7.5 cm. latis, basi attenuatis et in petiolum decurrentibus, apice cuspidatis vel subito caudato-acuminatis (acumine 1–1.5 cm. longo acuto), margine undulatis et siccitate anguste revolutis, utrinque leviter rugulosis in sicco fuscis et saepe subtus paullo pallidioribus, costa conspicua supra subplana subtus prominente, nervis secundariis utrinsecus 11–14 arcuato-adscendentibus inconspicue anastomosantibus supra leviter impressis subtus valde prominulis, venulis immersis obscuris; fructibus ut videtur solitariis e ramulis infra folia orientibus, pedicellatis (pedicellis ad 2.5 mm. diametro et 15 mm. longis), inaequaliter subgloboso-ellipsoideis, 3.5–4 cm. longis, 3–3.7 cm. latis, longitudinaliter indistincte carinatis, pericarpio 6–14 mm. crasso extus sublevi et remote verrucoso, arillo integro, semine oblongo-ellipsoideo 22–24 mm. longo 13–15 mm. lato, testa tenui levi.

BRITISH NEW GUINEA: Biriatabu, *Brass 610* (TYPE), alt. 450 m., Nov. 11, 1925 (compact tree 10 m. high in rain-forest, the bark channelled, scaly, light brown; fruit compressed, brown).

Horsfieldia pachycarpa is well characterized by its very short stout petioles, obovate few-nerved leaf-blades, and especially by its large thick-walled fruits. In foliage it suggests both *H. tuberculata* (K. Schum.) Warb. and *H. olivaeformis* Warb., but obviously differs from both in the above-mentioned characters. The type of the new species was mentioned by Markgraf (in White, Jour. Arnold Arb. **10**: 214. 1929) as *Myristica* sp.

Horsfieldia congestiflora sp. nov.

Arbor ad 15 m. vel plus alta ubique praeter inflorescentiam et partes novellas demum glabra; ramulis gracilibus subteretibus juventute arcte

ferrugineo-tomentellis; petiolis anguste alatis 8–15 mm. longis ut ramulis tomentellis; laminis chartaceis siccitate fuscis anguste elliptico-oblongis, 20–25 cm. longis, 5–8 cm. latis, basi obtusis vel subrotundatis, apice plerumque longe acuminatis interdum conspicue cuspidatis, margine subplanis, utrinque minute verrucosis vel interdum sublevibus, costa supra subplana vel leviter elevata subtus prominente, nervis secundariis utrinsecus 16–18 patentibus marginem versus inconspicue anastomosantibus supra subplanis vel inconspicue elevatis subtus prominulis, venulis laxe reticulatis supra obscuris subtus leviter prominulis; inflorescentiis ♂ amplis multifloris laxe paniculatis 3–5-plo ramosis, ad 15 cm. longis et 8 cm. latis, pedunculo gracili ut videtur ad 4 cm. longo et rhachi saepe flexuosa ramulisque conspicue ferrugineo-tomentellis (pilis copiose ramosis) demum subglabris; floribus 8–15 in fasciculos dense confertos apices ramulorum versus aggregatis, bracteis deltoideo-oblongis puberulis ad 2 mm. longis mox caducis; pedicellis gracillimis 0.5–1 mm. longis mox glabris; perianthio glabro subgloboso tenui sub anthesi 1–1.3 mm. diametro profunde bilobato, conspicue nigro-glanduloso; androecio obovoideo 0.7–1 mm. longo, stipite quam antheris paullo breviore basi angustato, antheris 7 vel 8 apice liberis et conspicue incurvatis; inflorescentiis fructiferis crassis ad 10 cm. longis, fructibus paucis maturitate aurantiacis anguste elliptico-ovoideis, 4–5 cm. longis, 1.5–2.5 cm. latis, bicostatis, basi et apice subacutis, pericarpio basim versus ad 3 mm. distaliter circiter 1 mm. crasso extus plerumque verrucoso, arillo carnoso rubro (ex Brass), semine anguste ovoideo, testa siccitate leviter sulcata cinerea.

British New Guinea: Western Division, Lower Fly River, east bank opposite Sturt Island, *Brass 8010* (type), October 1936, common in rain-forest on river flood-plains (stem prominently flanged at base; bark reddish, very thick and hard, with pitted flaky surface; flowers yellow, fragrant); Palmer River, 2 m. below junction of Black River, *Brass 6969*, common in forest substage on river banks (branches drooping, leafy toward apices; fruiting inflorescences lateral on old wood). Staminate inflorescences are described from the type and fruits from *Brass 6969*.

Horsfieldia congestiflora is well-marked by its minute and densely crowded staminate flowers on ample inflorescences which are tomentellous, at least until anthesis. These characters readily distinguish it from other Papuan species. Its closest relative is apparently *H. pilifera* Markgraf, from which the new species differs in the above mentioned characters, its proportionately somewhat narrower leaf-blades with more obviously elongate apices and more numerous secondaries, its glandular

perianth, and its androecium with an obvious stalk and fewer anthers, which are inflexed at the apices.

MYRISTICA L.

Myristica Markgraviana sp. nov.

Arbor, ramulis gracilibus juvenilibus leviter angulatis arcte et densissime ferrugineo-tomentellis demum teretibus cinereis glabris; petiolis supra complanatis 15–25 mm. longis ut ramulis juventute tomentellis mox glabris; laminis chartaceis fuscescentibus oblongo-ellipticis, 12–17 cm. longis, 5–8 cm. latis, basi obtusis vel subacutis, apice ut videtur cuspidatis vel breviter acuminatis, supra saepe nitidis praeter costam interdum tomentellam glabris, subtus pallidioribus et (praecipue ad nervos) parce brunneo-tomentellis demum glabris, costa valida supra subplana subtus prominente, nervis secundariis utrinsecus 12–15 patentibus rectis margines versus arcuatis et inconspicue anastomosantibus supra impressis subtus valde prominulis, venulis obscuris interdum supra leviter impressis et subtus inconspicue prominulis; inflorescentiis ♂ axillaribus paucifloris 3–6 cm. longis pauciramosis ubique densissime ferrugineo-velutinis (pilis saepe ad 1.5 mm. longis infra medium dense et breviter plumosis), pedunculo brevi vel subnullo et rhachi 2–3 mm. diametro; floribus 2–5 in fasciculos ad apices inflorescentiae ramulorum aggregatis vel interdum apices versus solitariis, bracteis parvis, pedicellis validis sub anthesi 6–13 mm. longis apice bracteola carnosa late suborbiculari-ovata rotundata circiter 2–3 mm. longa et 3–5 mm. lata intus glabra bracteolatis; perianthio crasse carnoso ellipsoideo vel obovoideo, sub anthesi 6–10 mm. longo et 5–7 mm. diametro, intus glabro, lobis 3 oblongo-deltoideis subacutis 2–4 mm. longis; androecio quam perianthio paullo breviore, stipite 1–2 mm. longo crasso (0.6–0.8 mm. diametro) striato, antheris 16 vel 17, 4–7 mm. longis, ad columnam crassam subtrigonam adnatis.

NORTHEASTERN NEW GUINEA: Morobe District, Quembung, *Clemens 1142* (TYPE), alt. 650–900 m., December 11, 1935; Minjem region, Kaulo, near Stephansort, *Schlechter 16789* (A, NY), alt. 300 m.

The Schlechter specimen was cited by Markgraf (Bot. Jahrb. **67**: 158. 1935) as *M. philippensis* Lam., which probably does not occur in New Guinea and which differs from *M. Markgraviana* in its more numerous staminate flowers with shorter pedicels, much larger bracteoles, and closer and paler tomentum. The leaf-blades of the Philippine species average considerably longer than those of the new species and have more numerous secondaries. Among Papuan species, *M. Markgraviana* is perhaps closest to *M. velutina* Markgraf and *M. cucullata* Markgraf, but

the type of inflorescence, the broadly ellipsoid perianth, the pubescence, and leaf-characters readily distinguish it.

Myristica fusca Markgraf, Bot. Jahrb. **67:** 158. 1935.

Netherlands New Guinea: Bernhard Camp and vicinity, Idenburg River, *Brass & Versteegh 13185,* alt. 800 m., frequent in rain-forest on slopes (tree 22 m. high, the trunk 50 cm. diam., the crown not wide-spreading, the bark 15 mm. thick, black, scaly, exuding a red sap, the wood red-brown); *Brass & Versteegh 13545,* alt. 100 m., frequent in rain-forest on lower mountain slopes (tree 29 m. high, the trunk 40 cm. diam., the crown, bark, and wood as above, the flowers yellow).

This well-marked species has been reported only from the three collections mentioned by Markgraf from Northeastern New Guinea. The following description of the fruit, previously apparently unknown, is taken from *Brass & Versteegh 13185*:

Fruiting pedicels terete, stout (5–6 mm. diam.), about 1 cm. long; fruits narrowly ellipsoid, 4.5–6 cm. long, 2–3 cm. diam., persistently and densely brown-tomentellous, obtuse at base, subacute or bluntly mucronate at apex, the pericarp about 1.5 mm. thick, the aril deeply laciniate, the seed oblong-ellipsoid, up to 3.5 cm. long and 1.8 cm. diam., dark brown when dried.

Myristica Hollrungii Warb. Nova Acta Acad. Leop.-Carol. **68:** 490. 1897; Warb. in K. Schum. & Lauterb. Fl. Deutsch. Schutzg. Südsee 328. 1901; Markgraf, Jour. Arnold Arb. **10:** 213. 1929; Markgraf, Bot. Jahrb. **67:** 159. 1935.

British New Guinea: Western Division, Wuroi, Oriomo River, *Brass 5765* (A, NY), *5766* (A, NY) (the principal tree on low river-banks frequently covered by tidal backwater; erect tree 15–20 m. tall, the bark dark gray and rough, the lower trunk frequently producing clumps of long stout down-turned adventitious roots, the branchlets and leaf-nerves yellowish, the leaf-blades smooth, glaucous beneath; fruit yellow-green, to 4.5 cm. long and 3.3 cm. broad, the aril red); east bank of lower Fly River, opposite Sturt Island, *Brass 8008* (the characteristic tree of a specialized type of tall forest restricted to low flood-plains frequently inundated by high tides, attaining a height of over 30 m. and a girth of 2 m., the trunk long and straight, supporting a spreading crown on rather weak branches, and with a great development of *Rhizophora*-like flying-buttress roots at base; leaves glaucous beneath; fruit yellow, ovate, about 4 cm. long, the aril red; vernacular name: nutmeg mangrove).

Although several specimens of this species have been mentioned by Markgraf, the above records are listed because, to the best of my knowledge, the peculiar habit and habitat have not otherwise been detailed.

Myristica Kajewskii sp. nov.

Arbor ad 20 m. alta ubique praeter fructus et probabiliter inflorescentiam glabra, ramulis robustis (apices versus 3–6 mm. diametro) subteretibus saepe striatis fuscis vel nigrescentibus; petiolis crassis (3–4 mm. diametro) supra canaliculatis 2.5–4 cm. longis; laminis subcoriaceis siccitate fusco-olivaceis elliptico-oblongis, 20–33 cm. longis, 7–13 cm. latis, basi rotundatis vel subobtusis et in petiolum breviter decurrentibus, apice subacutis vel obtusis, margine anguste recurvatis, supra saepe nitidis, subtus pallidioribus et canescentibus, costa valida supra leviter elevata subtus valde prominente, nervis secundariis utrinsecus 17–25 patentibus margines versus arcuatis et anastomosantibus supra subplanis vel leviter impressis subtus valde prominulis, venulis immersis vel interdum supra obscure impressis; fructibus axillaribus ut videtur solitariis, pedunculo crassissimo (9–12 mm. diametro) 1.5–2 cm. longo plus minusve verrucoso saepe obscure ferrugineo-tomentello; fructibus ovoideo-ellipsoideis, maturitate 5–7 cm. longis et 4–5.5 cm. latis (ad 8.5 × 7.5 cm. ex Kajewski), utrinque subrotundatis, apice saepe obscure apiculatis, extus rugosis densissime et arcte ferrugineo-tomentellis, pericarpio lignoso 5–10 mm. crasso, arillo fere a basi in lacinias latas paucas fisso, semine elliptico-oblongo, 30–35 mm. longo, 17–22 mm. lato, arilli impressionibus leviter sed distincte sulcato, testa dura castanea circiter 0.8 mm. crassa.

SOLOMON ISLANDS: Bougainville: Kupei Gold Field, *Kajewski 1736,* alt. 1000 m. (large tree to 20 m. high, the leaves silvery beneath); Lake Luralu, Koniguru, Buin, *Kajewski 2068,* alt. 1500 m. (tree to 10 m. high, growing in a region of stunted forest; fruit to 8.5 by 7.5 cm., with a spicy fragrance). Guadalcanal: Ululolo, Tutuve Mt., *Kajewski 2613* (TYPE), alt. 1200 m., May 2, 1931 (large tree to 20 m. high, with fair-sized buttresses; common name: *Hig-hambure;* bark macerated and the liquid drunk to check haemorrhages).

Myristica Kajewskii, which the collector notes as common in rainforest at the listed altitudes, is characterized by its large long-petioled leaves and extremely large thick-walled pubescent fruits. As all the specimens lack flowers, it is difficult to relate the species accurately, but on other characters it suggests *M. Hollrungii* Warb., a lowland Papuan species with shorter petioles and smaller glabrous fruits.

Myristica petiolata sp. nov.

Arbor ubique praeter fructus et certe inflorescentiam (non visam) glabra, ramulis (apices versus 3–5 mm. diametro) subteretibus rugosis siccitate fuscis; petiolis 2.5–6 cm. longis 2–3.5 mm. diametro valde rugosis supra canaliculatis; laminis subcoriaceis fusco-olivaceis elliptico-oblongis, 19–23 cm. longis, 5–9 cm. latis, basi rotundatis vel late obtusis et in petiolum decurrentibus, apice cuspidatis vel breviter acuminatis (acumine ipso obtuso), utrinque levibus et concoloribus, costa supra subplana vel acute prominula subtus valde prominente, nervis secundariis utrinsecus 22–25 patentibus rectis margines versus obscure anastomosantibus supra subplanis subtus paullo prominulis, venulis immersis; fructibus solitariis vel 2–4 ad apicem pedunculi crassi (4–5 mm. diametro) ad 1 cm. longi verrucosi aggregatis, pedicellis brevibus crassis arcte tomentellis; fructibus oblongo-ellipsoideis, 3–3.5 cm. longis, 1.7–2 cm. latis, basi rotundatis, apice obtuse apiculatis, densissime et arctissime spadiceo-velutinis (pilis ad 2 mm. longis persistentibus), pericarpio lignoso 1.5–3 mm. crasso, arillo fere a basi in lacinias latas fisso, semine ellipsoideo.

Solomon Islands: Ysabel: Tatamba, *Brass 3434A* (type), in hardwood forests, alt. 50 m., January 5, 1933 (tall slender tree, the bark gray, slightly fissured, the branchlets rusty brown).

As the above-cited collection bears only fruits and leaves, it cannot accurately be placed within the genus, but I feel certain that it represents an undescribed species. It is characterized by its long-petioled leaves and by the remarkably long and thick tomentum of its fruits. A species of somewhat similar aspect is the Papuan *M. subcordata* Bl., with petioles hardly exceeding 1 cm. in length and with paler and less dense fruit-pubescence. The discovery of flowers, however, may prove *M. petiolata* to have other relationships.

Myristica pachyphylla sp. nov.

Arbor ad 22 m. alta praeter inflorescentiam et fructus immaturos breviter pilosos glabra, trunco gracili ad 50 cm. diametro, ramulis gracilibus teretibus interdum leviter flexuosis; petiolis gracilibus (1–2 mm. diametro) 8–15 mm. longis conspicue canaliculatis; laminis tenuiter coriaceis fusco-olivaceis ovato-oblongis, 9–17 cm. longis, 3–7 cm. latis, basi obtusis et in petiolum decurrentibus, apice gradatim et longe attenuatis (acumine gracili 1–2 cm. longo), margine saepe anguste recurvatis, subtus paullo pallidioribus et interdum parce brunneo-punctatis, costa valida supra conspicue elevata subtus prominente, nervis secundariis utrinsecus 12–22 patentibus rectis margines versus anastomosantibus

supra acute impressis subtus prominulis, in intervallis nervis brevioribus tenuioribusque parallelis interdum interjectis, venulis plerumque supra impressis subtus obscuris; inflorescentiis ♂ supraaxillaribus vel ex axillis defoliatis 1.2–2 cm. longis plurifloris ubique sub anthesi minute et sparse brunneo-pilosis demum glabris, pedunculo gracili (circiter 1 mm. diametro) 3–10 mm. longo, rhachi cicatricibus florum delapsorum conspicue ornata, bracteis minutis ovatis mox caducis; floribus inflorescentiae apicem versus congestis, pedicellis gracilibus ad 4 mm. longis bracteola inconspicua ovata rotundata 0.5–1 mm. longa paullo infra floris basim ornatis; perianthio carnoso cylindrico-ellipsoideo, sub anthesi 5.5–6.5 mm. longo et basim versus 2–2.5 mm. diametro, lobis 3 deltoideis subacutis circiter 1 mm. longis; androecio 4–4.5 mm. longo, stipite glabro gracili 2–3 mm. longo, antheris 10 vel 11 circiter 1.5 mm. longis, columna in apicem sterilem brevem interdum obtusa; fructibus solitariis vel binis, pedunculo (e pedicello haud distinguitur) 1.5–3 mm. crasso 7–13 mm. longo glabro; fructibus oblongo-ovoideis, 3.5–4.5 cm. longis, 1.5–2 cm. latis, utrinque obtusis (juventute subattenuatis et apice mucronatis), arcte spadiceo-puberulis mox glabris, pericarpio 1–2 mm. crasso, arillo fere a basi laciniis angustis diviso, semine ellipsoideo.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass 12147*, alt. 1800 m. (slender tree 5–6 m. high, frequent in seral growths of openings in mossy forest; fruit orange, the aril red); *Brass 12173* (TYPE), alt. 1800 m., January 1939 (slender tree 6–7 m. high, common in mossy forest substage); *Brass & Versteegh 11925*, alt. 1780 m. (tree 19 m. high, the trunk 35 cm. diam., the crown small, the bark black, fairly smooth, about 7 mm. thick, the wood light brown; fruits yellow-brown; rare in primary forest on slope of a ridge); 6 km. southwest of Bernhard Camp, *Brass & Versteegh 12597*, alt. 1250 m. (tree 22 m. high, the trunk 49 cm. diam., the crown not widespreading, the bark black, 5 mm. thick, with red latex, the wood light red; fruits green; occasional tree of primary forest on a ridge).

The type bears staminate inflorescences, the other specimens fruits. *Myristica pachyphylla* is closely related to *M. crassipes* Warb., differing in its thicker and proportionately broader leaf-blades, its much more slender peduncle (of both staminate and fruiting inflorescence), and its glabrous androecium-stalk.

Myristica multinervia sp. nov.

Arbor ubique praeter inflorescentiam glabra, ramulis crassis (apices versus 4–6 mm. diametro) subteretibus juventute purpurascentibus demum fusco-cinereis et copiose lenticellatis; petiolis 2.5–3 mm. dia-

metro 17–23 mm. longis profunde canaliculatis nigrescentibus; laminis siccitate tenuiter coriaceis oblongis, 20–32 cm. longis, 8.5–10 cm. latis, basi rotundatis, apice ut videtur breviter acuminatis, utrinque siccitate fuscis vel subtus pallidioribus, costa valida supra plana subtus prominente, nervis secundariis utrinsecus 27–33 patentibus margines versus anastomosantibus supra impressis subtus valde prominulis, venulis immersis; inflorescentiis ♂ axillaribus vel e ramulis infra folia orientibus, pedunculo brevi crasso et rhachi cicatricibus florum delapsorum densissime ornata 5–7 mm. diametro sub anthesi 15–35 mm. longis, bracteis mox caducis; floribus apicem rhacheos versus congestis, ubique extus breviter et densissime fulvo-tomentellis, pedicellis sub anthesi 6–8 mm. longis et circiter 1.5 mm. diametro bracteola deltoidea subacuta 4–5 mm. longa et lata apice ornatis; perianthio cylindrico-urceolato, sub anthesi 9–11 mm. longo et circiter 4 mm. diametro, lobis 3 oblongo-deltoideis obtusis 1.5–2 mm. longis; androecio 6–7.5 mm. longo, stipite crasso 2–3 mm. longo dense et breviter stramineo-sericeo, antheris 14–16, 3–3.5 mm. longis, columna in apicem sterilem conspicuum acutum circiter 1 mm. longum producta.

British New Guinea: Central Division, Dieni, Ononge Road, *Brass 3914* (A, type, NY), alt. 500 m., April 29, 1933 (specimens brought down in thick forest by a falling tree; habit uncertain; leaves pale-veined above, iridescent pale brown beneath; flowers covered with yellow-brown pubescence).

This very distinct species is readily recognized by its firm many-nerved leaf-blades with rounded base and its short stout many-flowered inflorescences. It has essentially the same type of inflorescence as *M. subalulata* Miq., from which it differs in its terete branchlets, stouter rachises, shorter pedicels, and minor characters of foliage.

Myristica sphaerosperma sp. nov.

Arbor ad 13 m. alta ubique praeter fructus glabra, ramulis subteretibus distaliter 3–5 mm. diametro fuscis verrucosis; petiolis crassis (3–4 mm. diametro) leviter canaliculatis nigrescentibus 17–25 mm. longis; laminis subcoriaceis elliptico-oblongis, 20–32 cm. longis, 6–10.5 cm. latis, basi rotundatis vel obtusis, apice caudato-acuminatis (acumine 15–25 mm. longo angusto obtuso), margine leviter recurvatis, supra fuscis, subtus cineraceis vel argenteis, costa valida supra subplana vel leviter elevata subtus valde prominente, nervis secundariis utrinsecus 20–25 arcuato-patentibus margines versus conspicue anastomosantibus supra acute impressis subtus prominentibus, venulis supra leviter impressis vel planis subtus immersis vel paullo prominulis; fructibus infra folia solitariis,

pedunculo crasso (5–7 mm. diametro) ruguloso ad 15 mm. longo; fructibus subglobosis ad 6 cm. diametro utrinque rotundatis extus rugosis densissime et arctissime rufo-tomentellis, pericarpio duro 3–4 mm. crasso, arillo fere a basi in lacinias numerosas angustas fisso, semine subgloboso 3–3.5 cm. diametro, arilli impressionibus distincte sulcato, testa pallide badia dura 0.7–1 mm. crassa.

BRITISH NEW GUINEA: Central Division, Mt. Tafa, *Brass 4174* (A, TYPE, NY), alt. 2100 m., June 1, 1933 (rare, in foothill forest substage; erect shortly branched tree 13 m. high, with slightly fissured dark brown bark; leaves silver-gray beneath, the nerves brownish green beneath; fruit rufous-brown, the aril of unripe fruit pale yellow).

In the absence of inflorescences, this species cannot be accurately related; it is, however, amply characterized by its large thick many-nerved leaf-blades, which are whitish beneath, and by its large subglobose pubescent fruit. Its closest relative may be *M. argentea* Warb., a species with fewer secondary nerves and an ellipsoid fruit.

Myristica Brassii sp. nov.

Arbor ad 29 m. alta ubique praeter inflorescentiam et fructus et partes novellas brunneo-puberulas glabra, trunco ad 70 cm. diametro, ramulis crassis subteretibus fusco-cinereis; petiolis crassis (circiter 3 mm. diametro) 13–20 mm. longis canaliculatis nigrescentibus; laminis tenuiter coriaceis vel chartaceis ovato-oblongis, 15–24 cm. longis, 6.5–10 cm. latis, basi rotundatis vel obscure subcordatis, apice acutis vel gradatim acuminatis, margine saepe revolutis, supra fuscis, subtus paullo pallidioribus, costa valida supra prominente subtus valde prominente, nervis secundariis utrinsecus 15–17 patentibus margines versus adscendentibus et inconspicue anastomosantibus supra impressis vel costam versus prominulis subtus prominentibus, venulis utrinque obscuris vel supra immersis et subtus leviter prominulis; inflorescentiis ♂ supraaxillaribus vel e ramulis infra folia orientibus brevibus paucifloris sub anthesi ubique pallide ferrugineo-sericeis (pilis adpressis 0.2–0.5 mm. longis), pedunculo subglomerulato ad 5 mm. longo et crasso cicatricibus florum delapsorum ornato, bracteis parvis mox caducis; floribus congestis, pedicellis crassis sub anthesi 6–8 mm. longis bracteola crasso-carnosa late semiorbiculari ad 1 mm. longa 2–4 mm. infra floris basim ornatis; perianthio carnoso urceolato-ovoideo, sub anthesi 12–13 mm. longo et basim versus circiter 5 mm. diametro, demum subglabrescente, apicem versus contracto, lobis 3 oblongo-deltoideis subacutis, 1.5–2 mm. longis, 2–2.5 mm. latis; androecio quam perianthio paullo breviore, stipite glabro crasso striato 4–5 mm. longo, antheris 15–20, 4–5.5 mm. longis,

columna in apicem sterilem 0.5–1 mm. longum subacutum producta; inflorescentiis ♀ plus minusve similibus dense tomentellis (pilis 0.5 mm. longis patentibus persistentibus basim versus plumulosis); pedicellis bracteola 1–1.5 mm. infra floris basim ornatis; perianthio breviore (sub anthesi 10–11 mm. longo) circiter 6 mm. diametro; ovario ovoideo sub anthesi 4–5 mm. diametro dense pallide ferrugineo-sericeo ad apicem angustato et glabro, stigmate profunde sulcato; fructibus ut videtur solitariis, pedicello crasso (ad 10 mm. diametro) 15–20 mm. longo demum glabro; fructibus subglobosis 6–7 cm. diametro brunneo-tomentellis, pericarpio lignoso ad 1 cm. crasso, arillo fere a basi in lacinias angustas numerosas fisso, semine subgloboso in specimine nostro parvo (ad 2 cm. diametro).

Netherlands New Guinea: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass 12254* (type), alt. 1700 m., January 1939 (tree 6 m. high in a rain-forest gully; flowers fragrant, cream-colored); 6 km. southwest of Bernhard Camp, *Brass & Versteegh 12547*, alt. 1150 m. (frequent in primary forest, on slope of a ridge; tree 29 m. high, the trunk 70 cm. diam., the crown not wide-spreading; flowers yellow; fruits dark brown; bark 24 mm. thick, black, exuding abundant red latex; wood red).

The type bears staminate inflorescences, the other specimen pistillate inflorescences and fruits. This well-marked species bears a relationship to *M. velutina* Markgraf and *M. cucullata* Markgraf, differing from the former in its terete branchlets, broader leaf-blades, and much larger fruits, from the latter in its more obvious venation and small bracteoles, and from both in its larger flowers, long androecium-stalk, and several obvious foliage characters.

Myristica Archboldiana sp. nov.

Arbor ad 30 m. alta, ramulis apices versus purpurascentibus angulatis vel leviter 4-alatis; petiolis ut ramulis glabris gracilibus (1.5–2 mm. diametro) 2.5–3.5 cm. longis canaliculatis; laminis tenuiter coriaceis vel chartaceis elliptico-oblongis, 13–15 cm. longis, 6.5–7.5 cm. latis, basi rotundatis vel leviter subcordatis, apice cuspidatis vel breviter acuminatis, margine undulato-recurvatis, supra glabris fuscis, subtus indumento persistente arcte et densissime ferrugineo-tomentellis, costa supra acute elevata subtus prominente, nervis secundariis utrinsecus 17–21 erecto-patentibus rectis haud vel indistincte conjunctis supra acute impressis subtus valde prominulis, venulis immersis utrinque obscuris; fructibus 2 vel 3 apicem pedunculi brevis versus aggregatis, pedunculo ad 25 mm. longo et 5 mm. diametro glabro cortice soluto vestito, pedi-

cellis glabris crassis brevibus (ut videtur ad 3 mm. longis); fructibus obovoideis ad 7 cm. longis et 4 cm. diametro (paullo supra medium), basi angustatis apice rotundatis vel late obtusis, pericarpio suberoso vel demum fibroso 8–12 mm. crasso extus persistente et densissime arcte rufo- vel ferrugineo-tomentello, arillo in lacinias latas fisso, semine ellipsoideo in specimine nostro parvo (ad 2.5 cm. longo).

BRITISH NEW GUINEA: Western Division, Palmer River, 2 miles below junction with Black River, *Brass 6982* (TYPE), alt. 100 m., June 1936 (common in forest on the lower ridges; large canopy tree 30 m. tall, with a clear straight bole spurred at the very base, the bark pale brown, lenticellate, reddish when cut; leaf-blades brown beneath; ribbed above with impressed nerves; fruit rufous-brown, the aril yellow).

As this species is represented only by foliage and fruit, it cannot be accurately related, but I feel certain that it is not to be matched among described species. It is characterized by long petioles, elliptic-oblong bicolored leaf-blades which are closely and densely tomentellous beneath, and large obovoid pubescent thick-walled fruits. In fruit, the new species suggests *M. costata* Warb., from which it differs notably in the other above-mentioned characters. Discovery of flowers may indicate that *M. Archboldiana* is elsewhere related, but its leaf and fruit characters are sharply distinct from those of described Papuan species.

Myristica Schleinitzii Engl. Bot. Jahrb. **7**: 455. 1886; Warb. Nova Acta Acad. Leop.-Carol. **68**: 392, *pl. 19*. 1897; Markgraf, Bot. Jahrb. **67**: 166. 1935.

Myristica farocnsis Hemsl. Ann. Bot. **5**: 506. 1891.

SOLOMON ISLANDS: Bougainville: Kieta, *Kajewski 1582*, common in rain-forest (small tree, to 17 m. high; fruit yellow-green when ripe); Karngu, Buin, *Kajewski 2236*, common in rain-forest close to seashore (small tree about 15 m. high; leaves silvery beneath; fruit yellow-green, up to 43 mm. long and 15 mm. broad, the aril bright scarlet; common name: *U-we-pekira*). Navotana I., N'Gela group: *Brass 3237*, on summit of island, alt. 50 m. (slender tree 8 m. tall; leaves gray beneath; fruit pale yellow).

This species has been reported from many collections in New Guinea and the surrounding islands, but apparently it has been previously represented from the Solomons only by Guppy's type of *M. farocnsis* from Faro, in Bougainville Straits.

Myristica inutilis Rich; A. Gray, Bot. U. S. Expl. Exped. **1**: 34. 1854; Guillaumin, Jour. Arnold Arb. **14**: 59. 1933; Christophersen, B. P. Bish. Mus. Bull. **128**: 87. 1935.

SOLOMON ISLANDS: Bougainville: Kieta, *Kajewski 1587,* alt. 100 m. (large tree to 20 m. high; leaf-blades light brown beneath; fruit 4.5 cm. long, 2 cm. diam., covered with short brown felt-like tomentum); Lake Luralu, Koniguru, Buin, *Kajewski 2101,* alt. 1000 m. (tree to 20 m. high; leaf-blades golden beneath; fruit 3 cm. long, 1.8 cm. diam., short brown-tomentellous; common name: *Chigui*). San Cristoval: Star Harbour, *Brass 3106,* near sea-level (small slender tree with milky sap; leaf-blades dark green above, brown beneath; fruit rusty brown). The collectors report the species as common in rain-forest.

Myristica inutilis, originally described from Samoa and recently reported by Guillaumin from the New Hebrides, is now found to extend into the Solomons. I have carefully compared the cited specimens with those mentioned by Guillaumin (*Kajewski 44, 220,* and *757*) and with an extensive series from Samoa, and am unable to find any appreciable differences among specimens from the three groups. The New Hebrides specimens bear an unpublished herbarium name, but I have no reason to doubt the correctness of Guillaumin's determinations. The absence of the species from Fiji is noteworthy and is doubtless due to lack of abundant material from that group.

Myristica inutilis is a close relative of the Papuan *M. Buchneriana* Warb., from which it is readily distinguished by the presence of copious close pale tangled tomentum on the lower surfaces of leaf-blades. In floral characters the two species are extremely close, *M. inutilis* having a larger bracteole and fewer anthers; in fruit the similarity is also striking.

Myristica salomonensis Warb. Nova Acta Acad. Leop.-Carol. 68: 527. 1897.

SOLOMON ISLANDS: Guadalcanal: Ululolo, Tutuve Mt., *Kajewski 2552,* common in rain-forest, alt. 1200 m. (tree to 25 m. high, the trunk straight; fruit brown-tomentellous, with a strong spicy odor; common name: *Mansi-mansi*). Malaita: Quoi-mon-apu, *Kajewski 2373* (A, US), common in rain-forest, alt. 50 m. (small tree to 10 m. high; fruit brown-tomentellous, up to 3 by 2.5 cm.; common name: *Pai-passi*). San Cristoval: Magoha River, *Brass 2744,* common in lowland rain-forest (tree 15 m. high, the bark dark brown, slightly furrowed and flaky, the wood pale brown with darker streaks; fruit tomentellous, about 3 by 2.5 cm.).

The listed specimens are all in fruiting condition, as was the type and only previously known collection, *Comins 121,* from San Cristoval. Although I have not seen the latter specimen, I have little doubt of the

determination, as Warburg's description is ample. The leaves of the Brass specimen are slightly larger (to 17 by 6 cm.) than those mentioned in the original description. While the place of *M. salomonensis* in the genus must remain uncertain until flowers are available, it seems to be allied to *M. Buchneriana* Warb., differing obviously in fruit shape and details of foliage.

Myristica platyphylla sp. nov.

Arbor ad 20 m. alta, trunco interdum conspicue erismatico, ramulis crassis subteretibus vel obscure biangulatis; petiolis crassis (3–4 mm. diametro) 17–25 mm. longis conspicue canaliculatis; laminis chartaceis elliptico- vel leviter obovato-oblongis, 20–32 cm. longis, 7–13 cm. latis, basi obtusis, apice ut videtur breviter cuspidatis, supra fuscis nitidis glabris, subtus indumento pallide brunneo-tomentello arcto persistente densissime indutis, costa valida supra lata subplana vel leviter elevata subtus valde prominente, nervis secundariis utrinsecus 25–31 erecto-patentibus rectis margines versus inconspicue anastomosantibus supra leviter impressis subtus valde prominulis, venulis immersis plerumque utrinque obscuris; inflorescentiis ♂ supraaxillaribus vel e ramulis infra folia orientibus 1–1.5 cm. longis multifloris ubique praeter pedunculum densissime ferrugineo-tomentellis (pilis minutis e basi pauciramosis), pedunculo crasso basim versus 2–4-furcato, rhachibus brevibus crassis conspicue cicatricosis, bracteis minutis mox caducis; floribus inflorescentiae apices versus dense congestis, pedicellis gracilibus ad 4 mm. longis bracteola tenuiter carnosa deltoideo-ovata 2–2.5 mm. longa et lata subacuta intus glabra apice ornatis; perianthio ellipsoideo 4.5–5 mm. longo 2–3 mm. diametro, lobis 3 deltoideis subacutis 1–1.5 mm. longis et latis; androecio 4–4.5 mm. longo, stipite crasso striato 1.5–2 mm. longo basim versus pilis brevibus stramineis adscendentibus obscure piloso, antheris 8 vel 9, 2–2.5 mm. longis, columna in apicem sterilem brevem obtusa; fructibus 2–4 aggregatis, pedunculo crasso brevi, pedicellis 3–5 mm. crassis 4–8 mm. longis demum glabrescentibus; fructibus late ellipsoideis circiter 3 cm. longis et 2.5 cm. latis, longitudinaliter sulcatis, utrinque rotundatis vel apice inconspicue mucronatis, pericarpio duro 3–4 mm. crasso extus densissime et arcte pallide brunneo-tomentello, arillo fere a basi in lacinias latas paucas irregulariter fisso, semine oblongo-ellipsoideo ad 20 mm. longo et 13 m. lato.

SOLOMON ISLANDS: Bougainville: Kugumaru, Buin, *Kajewski 1916*, alt. 150 m. (large tree to 20 m. high; leaf-blades brown beneath; fruit covered with brown tomentum and longitudinally dehiscing

on one side; common name: *Chigui*). Guadalcanal: Berande, *Kajewski 2442* (TYPE), near sea-level, January 14, 1931 (large tree to 20 m. high, with large buttresses; leaf-blades green above, light brown beneath; buds brown-tomentellous; common name: *Toro-bagere;* latex reported used to check nasal haemorrhages).

Myristica platyphylla, said to be common in rain-forest, seems very distinct and without close relatives among described Papuasian species. It is at once distinguished by its large many-nerved leaf-blades which are persistently tomentellous beneath, its short stout branched many-flowered staminate inflorescences, and its comparatively small tomentellous fruits. According to Markgraf's key, it may be placed near *M. Buchneriana* Warb., but the differences in foliage and fruit are very pronounced. A closer relative appears to be the Philippine *M. Wenzelii* Merrill, a species with ultimately glabrous leaf-blades, simple or obscurely forked staminate inflorescences, shorter pedicels, and more numerous anthers. The type of *M. platyphylla* bears staminate inflorescences, the other specimen being in fruit.

Myristica cerifera sp. nov.

Arbor ad 25 m. alta ubique praeter inflorescentiam et fructus glabra, ramulis subteretibus crassis (3–6 mm. diametro) rugosis; petiolis nigrescentibus crassis (3–4 mm. diametro) 15–25 mm. longis conspicue canaliculatis; laminis chartaceis elliptico-oblongis, 30–40 cm. longis, 8–12.5 cm. latis, basi obtusis vel rotundatis, apice obtusis vel obtuse cuspidatis, margine paullo undulatis, supra fuscis nitidis, subtus levibus et manifeste argenteo- vel cinereo-ceriferis, costa valida supra lata et prominente subtus valde prominente, nervis secundariis utrinsecus 25–30 basim versus valde adscendentibus distaliter arcuato-adscendentibus margines versus inconspicue anastomosantibus supra leviter impressis subtus valde prominulis, venulis immersis utrinque obscuris vel supra leviter impressis et subtus minute prominulis; inflorescentiis ♀ vetustis e ramulis defoliatis orientibus vermiformibus 2.5–3.5 cm. longis multifloris, pedunculo brevi crasso 2- vel 3-furcato, rhachibus crassis (6–10 mm. diametro) conspicue et densissime cicatricosis; floribus inflorescentiae apices versus dense congestis ubique extus dense et breviter ferrugineo-tomentellis, pedicellis brevissimis bracteola chartacea late ovata circiter 3 mm. longa et 7 mm. lata obtusa apice ornatis; perianthio crasse carnoso ellipsoideo 6–7 mm. longo (ante anthesi) 5–6 mm. diametro, lobis 3 vel 4 deltoideo-oblongis acutis circiter 3 mm. longis et latis; ovario ovoideo densissime brunneo-strigoso, stigmate profunde lobato

glabro; fructus pedunculo pedicellisque valde incrassatis; fructibus paucis (solitariis?) oblongo-ellipsoideis, 5–8 cm. longis, 4–5 cm. latis, utrinque rotundatis vel apice inconspicue mucronatis, pericarpio lignoso 5–10 (ad 17 ex Kajewski) mm. crasso extus conspicue et valdissime verrucoso arcte brunneo-tomentello demum glabro, arillo crasso fere a basi in lacinias latas fisso, semine oblongo-ellipsoideo ad 45 mm. longis et 18 mm. latis (ad 56 × 21 mm. ex Kajewski), testa castanea dura circiter 1 mm. crassa arilli impressionibus conspicue sulcata.

SOLOMON ISLANDS: Bougainville: Kugumaru, Buin, *Kajewski 1827* (TYPE), alt. 150 m., June 7, 1930, common in rain-forest (large tree to 25 m. high; leaf-blades silvery beneath; fruit brown, rough-surfaced; common name: *Or-wu-pekira;* seeds pulverized and used to stop leaks in canoes); Siwai, *Waterhouse 166* (NY, Y) (large tree; fruits woody, the aril red; common names: *Voraga, Mu*).

Both the cited specimens are in fruit, and the type also retains some old pistillate inflorescences. The species is readily recognized by its large leaf-blades, which are covered on the lower surface by a uniformly thick layer of wax, its stout vermicular inflorescences, and its large thick-walled verrucose fruits. Its leaf-shape and the form of its inflorescence indicate a relationship with the preceding new species (*M. platyphylla*), but the waxy foliage and the fruits yield strikingly distinct characters.

Myristica Clemensii sp. nov.

Arbor ubique praeter inflorescentiam et partes novellas parce et breviter ferrugineo-strigillosas glabra, ramulis gracilibus subteretibus interdum leviter flexuosis; petiolis gracilibus (1–1.5 mm. diametro) nigrescentibus 12–17 mm. longis canaliculatis; laminis chartaceis siccitate fuscis et concoloribus anguste elliptico-oblongis, 8–11 cm. longis, 1.8–2.8 cm. latis, basi acutis et in petiolum decurrentibus, apice obtusis vel gradatim et obtuse acutis, margine valde revolutis, subtus inconspicue ceriferis, costa valida supra impressa vel leviter elevata subtus prominente, nervis secondariis utrinsecus 15–20 brevibus patentibus rectis inconspicue anastomosantibus supra leviter impressis subtus subplanis vel inconspicue prominulis, venulis immersis vel supra paullo impressis; inflorescentiis ♂ supraaxillaribus simplicibus, pedunculo circiter 2 mm. longo et 1.5 mm. diametro apice incrassato et paucifloro mox glabro, bracteis parvis ovatis strigosis; floribus fasciculatis, pedicellis gracilibus sub anthesi 3–4 mm. longis bracteola ovato-deltoidea circiter 1 mm. longa et 2 mm. lata obtusa apice ornatis; perianthio cylindrico-ellipsoideo 5–6 mm. longo 2–3 mm. diametro, lobis 3 (vel 4) oblongo-deltoideis circiter 2

mm. longis et latis; androecio 3.5–5 mm. longo, stipite crasso 1–1.5 mm. longo parce et breviter stramineo-strigilloso, antheris 10–15, 1.5–3 mm. longis, columna in apicem sterilem conspicuum circiter 0.5 mm. longum obtusum producta.

Northeastern New Guinea: Morobe District, Wareo, *Clemens 1668* (type), alt. 600–650 m., January 17, 1936.

Myristica Clemensii is related to *M. Macgregorii* Warb., from which it differs in its much narrower leaf-blades, which are brownish and concolorous rather than glaucous beneath, its more numerous and less conspicuous secondary nerves, and its much shorter pedicels. In other floral characters the two species are quite similar, but foliage differences in texture and venation, as well as in shape, are pronounced.

Myristica procera sp. nov.

Arbor procera, ramulis gracilibus (apices versus 2–4 mm. diametro) subteretibus juventute arcte ferrugineo-tomentellis demum glabris cinereis rugosis; petiolis crassis (2–3 mm. diametro) 12–15 mm. longis profunde canaliculatis ut ramulis juventute tomentellis; laminis subcoriaceis siccitate fusco-castaneis concoloribus elliptico-oblongis, (14–)20–25 cm. longis, 4–6 cm. latis, basi obtusis et in petiolum decurrentibus, apice gradatim et longe acutis (acumine ipso obtuso), margine leviter undulatis, supra glabris, subtus indumento pallide ferrugineo arcto persistente densissime tomentellis, costa supra leviter elevata subtus prominente, nervis secondariis utrinsecus 16–19 erecto-patentibus margines versus leviter arcuatis et anastomosantibus supra paullo impressis subtus prominulis, venulis immersis utrinque obscuris vel supra leviter impressis; fructibus solitariis axillaribus vel e ramulis inter folia orientibus, pedunculo (a pedicello haud distincto) crasso (3–3.5 mm. diametro) 6–7 mm. longo tomentello; fructibus ellipsoideis ad 2.5 cm. longis et 1.7 cm. latis, longitudinaliter conspicue sulcatis, basi obtusis, apice rotundatis et oblique apiculatis, pericarpio duro circiter 1.5 mm. crasso extus densissime et arcte ferrugineo-tomentello, arillo fere a basi in lacinias paucas latas fisso, semine oblongo-ellipsoideo.

Solomon Islands: Ysabel: Tatamba, *Brass 3434* (type), alt. 50 m., January 5, 1933, common in rain-forest (tall slender tree, the bark gray, slightly fissured, the branchlets rusty brown; upper surface of leaf-blades smooth, covered with gray bloom, the lower surface rusty-tomentose).

Myristica procera, a species characterized by the close persistent tomentum of the lower surface of leaf-blades and the fruit, appears not

to be closely related to any described Papuasian or Pacific species, and in the absence of flowers I cannot indicate a probable relationship. In its pubescence and general leaf-shape it bears a resemblance to the Philippine *M. guatteriaefolia* A. DC., but the relationship is probably not close. At the same time and in the same locality as the type of *M. procera* was obtained, Brass collected another species in fruit, referring it to his number *3434A*. I have described this above as *M. petiolata;* the two species are not closely related.

HERBARIUM, ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

ADDITIONS TO OUR KNOWLEDGE OF THE FIGS OF NEW GUINEA*

V. S. Summerhayes

In 1935 Diels (Engl. Bot. Jahrb. **67**: 177–235) published an account, with analytical keys, of all the *Ficus* species recorded from the island of New Guinea and the neighbouring Bismarck Archipelago, in which our knowledge of this genus was brought up to date.

Since then several valuable collections of figs made in New Guinea have been placed in my hands for study, resulting in the addition of many records to those given by Diels and the description of several new species. The notes here offered are based mainly on the collections of the first two Archbold Expeditions in 1933–4 and 1936–7, for the material of which I am indebted to the New York Botanical Garden and the Arnold Arboretum respectively; a complete account is given of these two collections. There are also included a number of interesting records from the large collections made in Eastern Papua by C. E. Carr, some of whose specimens have not yet been worked out finally, and from sundry other collections. I hope later to publish a further paper dealing with those specimens not cited here. For convenience the sequence followed is that of Diels, except in certain cases in which I disagree with his conclusions; these changes are commented on where they occur. It should not be assumed, however, that in the absence of comment I am necessarily in agreement with Diels, as the position of some species is still under consideration.

Sect. Urostigma

Ficus sterrocarpa Diels in Engl. Bot. Jahrb. **67**: 179 (1935).

Papua: Central Division, Boridi, 1500 m. alt., in forest, tree 24 m., fruit yellow-green, September 1935, *Carr 13371*.

Ficus sclerotiara Diels, l.c. 180.

Papua: Western Division, Fly River, 528 mile Camp, 80 m. alt., common large canopy tree (not constricting) on the ridges, grey, slightly flaky bark, dry stipules persistent, fruit green, very hard, ± 3.5 cm. diam., solitary or in pairs in upper leaf axils, May 1936, *Brass 6686*.

*Botanical Results of the Richard Archbold Expeditions.

This specimen differs from the specimens cited by Diels (*Schlechter 17765, 17501*) in the slightly different venation of the leaves and the glabrous stipules, stem, peduncles and receptacles. In floral structure, however, there is complete agreement.

Ficus myrmekiocarpa Summerhayes, sp. nov.; a *F. Watkinsiana* F. M. Bail. foliis majoribus latioribusque, receptaculis ellipticis paulo majoribus ostiolo latiore rotundato, florum masculorum bracteolis ellipticis, stigmate bifido differt.

Arbor magna; ramuli crassi, apice circiter 1 cm. diametro, glabri, cortice brunneo fere laevi obtecti, cicatricibus foliorum et stipularum delapsorum distincte notati. Folia longe petiolata, late vel anguste elliptica, apice cuspidato-acuminata, basi obtusa vel late cuneata, 12–27 cm. longa, 6–12 cm. lata, tenuiter coriacea, glaberrima, costa supra subimpressa subtus prominente, nervis lateralibus utrinsecus 20–30 infimis e costa angulo acuto exortis ceteris curvatim subpatentibus ± parallelis prope marginem nervo submarginali undulato conjunctis, nervis secundariis numerosis distinctis fere prominulis, rete venularum crebro indistincto; petiolus subteres, supra canaliculatus, 5–9 cm. longus, 2–4 mm. diametro, glaber, cortice brunneo leviter ruguloso obtectus; stipulae lanceolatae, acuminatae, usque ad 20 cm. longae, glabrae. Receptacula axillaria, bina vel abortu solitaria, pedunculata, ellipsoidea vel ovoideo-ellipsoidea, 3.5–4.5 cm. longa, 2.5–3 cm. diametro, apice producta, obtuse mammilliformia, 5 mm. alta et fere 1 cm. diametro, glabra vel sparse papillato-puberula, obtuse et indistincte verruculosa, valde indurata, aurantiaco-rubra, ostiolo vix prominente bracteis tribus incurvatis instructo; pedunculus 1–2 cm. longus, 4–5 mm. diametro, glaber, apice in discum cupularem pubescentem vel glabrum 8–15 mm. diametro dilatatus. Flores saepius e processubus irregularibus lignosis usque ad 7 mm. altis e pariete receptaculi ortis enati, cum squamis numerosis linearibus brunneis commixti. Flores masculi saepius ex apicibus processuum enati, usque ad 2.5 mm. pedicellati, bracteolis (apice pedicelli sitis) ovatis vel ellipticis 2–2.5 mm. longis; perianthii segmenta 3–4 orbicularia, rotundata, 1.6 mm. longa, rubro-brunnea, antheram aequantia; anthera subsessilis, reniformi-oblonga. Flores feminei e lateribus processuum vel rarius e pariete receptaculi enati, sessiles; perianthii segmenta 1–3, lanceolata, acuminata, 1–3 mm. longa, linea media rubra instructa; ovarium ± ovoideum sed saepius angulare, 2–3 mm. altum, intense rubro-brunneum, stylo infra-apicali vel laterali tenui usque ad 4 mm. longo, stigmate bifido segmentis filiformibus inclusis usque ad 1.5 mm. longo.

PAPUA: Western Division, Wuroi, Oriomo River, 5 m. alt., in river-

bank forest fringe, one example, spreading tree, 15 m. high, receptacles orange-red, January–March 1934, *Brass 5773* (TYPE); Lower Fly River, east bank opposite Sturt Island, on bank in rain forest, large tree, leaves greyish beneath, fruit hard, orange-red, October 1936, *Brass 8099*.

Evidently a close relative of *F. Watkinsiana* F. M. Bailey from Queensland, which has the same type of receptacle but differs in a number of minor points, particularly in the floral structure. The most striking difference is in the apex of the receptacle which in the Australian species is drawn out into a sort of short narrow proboscis but in *F. myrmekiocarpa* is broad and rounded resembling a mammilla. The specific epithet is given in allusion to the wart-like irregularities of the receptacle wall.

Ficus mafuluensis Summerhayes, sp. nov.; ab omnibus aliis speciebus novoguineensibus subsectionis (*Elasticarum*) receptaculis sessilibus usque ad 6–7 cm. longis induratis apice bracteis duabus compressis carinatis induratis coronatis distinguitur.

Arbor parva, epiphytica; ramuli erecti, crassi, apice 1 cm. diametro, sparse pubescentes, glauci, cicatricibus foliorum et stipularum delapsorum distincte notati. Folia longe petiolata, late elliptico- vel oblongo-lanceolata, apice breviter et subito acuminata, basi late cuneata, usque ad 24 cm. longa et 10 cm. lata, costa supra prominula subtus prominente ut nervi rubra, nervis lateralibus utrinsecus 20–25 duabus infimis angulo acuto exortis ceteris fere patentibus parallelis juxta marginem cum nervo submarginali leviter multiarcuato conjunctis utrinque prominulis, nervis secundariis numerosis, rete venularum indistincto, tenuiter coriacea, utrinque glabra, supra ± nitentia; petiolus semiteres, supra canaliculatus, 5–7 cm. longus, 3.5 mm. diametro, sparse pubescens, ruber; stipulae lanceolatae, acuminatae, 25–30 cm. longae, extra dense sericeo-canescentes, rubrae. Receptacula axillaria, bina, sessilia, ovoideo-cylindrica vel ovoidea, usque ad 6–7 cm. longa et 3.5–4 cm. diametro, leviter compressa et indistincte 2–4-costata, glabra, aurantiaca, indurata, basi disco cupulari pubescente 1–1.5 cm. diametro instructa, ostiolo prominente bracteis duabus oppositis compressis carinatis induratis instructo. Flores masculi cum femineis commixti, usque ad 2 mm. longe pedicellati, basi bracteolis duabus lineari-lanceolatis vel lanceolatis instructi; perianthii segmenta 3 vel 4, orbicularia, fere 2 mm. longa, pallide flavescentia; anthera sessilis, compressa, reniformis, 2 mm. lata. Flores feminei sessiles; perianthii segmenta 3–4, lineari-lanceolata, rubro-brunnea, 1–2 mm. longa; ovarium ovoideum vel ± globosum, 1.5–2 mm. altum, atro-brunneum, stylo laterali tenui, stigmate breviter bifido pallidiore.

PAPUA: Central Division, Mafulu, 1200 m. alt., in lower primary forest, uncommon, epiphyte in crown of a very large tree, robust species attaining the proportions of a small tree, branchlets erect, these and petioles glaucous, leaves slightly concave, midrib and nerves red, stipules red, receptacles hard, orange, in axillary pairs, 6–7 cm. long, 3.5–4 cm. diam., September–November 1933, *Brass 5398*.

Easily distinguishable from other Papuan representatives of Sub-Sect. *Elasticae* by the fruit characters as mentioned in the diagnosis. The species resembles *F. pleurocarpa* but differs in a number of minor points such as the indumentum of the twigs, the venation of the leaves, the stipules and the stigmas. Unfortunately, I have not seen authentic material of *F. pleurocarpa* but sterile material in the Brisbane Herbarium, some from the type locality, agrees pretty well with the original description.

Ficus Archboldiana Summerhayes, sp. nov.; a *F. elastica* Roxb. foliis minoribus, receptaculis globosis bracteis ± orbicularibus persistentibus, a *F. retusa* L. foliis coriaceis nervis lateralibus numerosis subaequalibus, receptaculis bracteisque majoribus, ab utraque florum femineorum perianthio gamophyllo, anthera valde exserta differt.

Arbor juventute epiphytica, usque ad 25 m. alta, omnino glaberrima; ramuli siccitate longitudinaliter rugulosi, cortice atro-brunneo obtecti. Folia modice petiolata, elliptica, oblongo-elliptica vel elliptico-oblanceolata, apice subito breviter apiculato-acuminata, basi rotundata usque cuneata, 6–11 cm. longa, 3–5.5 cm. lata, tenuiter coriacea, costa supra prominula subtus prominente, nervis lateralibus numerosis subaequalibus ± parallelis marginem versus reticulato-conjunctis nervum submarginalem irregularem efformantibus, utrinque laevia, supra subnitida; petiolus semiteres, supra anguste canaliculatus, 1.5–3 cm. longus; stipulae lanceolatae, acuminatae, extra atro-brunneae, intus pallidiores, usque ad 2.5 cm. longae. Receptacula axillaria, bina, sessilia, globosa, ± 1.3 cm. diametro, bracteis basalibus tribus subreniformi-orbicularibus vel orbicularibus 6–7 mm. longis 6–8 mm. latis persistentibus instructa, ochracea vel rubro-brunnea, laevia, ostiolo vix distincto bracteis incurvatis, extra et intus glabra. Flores masculi, feminei cecidiophori et feminei per totum receptaculum commixti. Flores masculi sessiles; perianthium gamophyllum, turbinato-tubulosum, apice irregulariter fissum, 1.5 mm. longum, rubro-brunneum; stamen 1, perianthium duplo superans. Flores feminei cecidiophori sessiles; perianthii segmenta 3–4, ligulata, subacuta vel obtusa, 1.5 mm. longa, rubro-brunnea; ovarium obovoideum, 1 mm.

longum, crasse stipitatum, stylo apicali brevi. Flores feminei sessiles; perianthii segmenta 3–4, ligulata, 1.5 mm. longa, rubro-brunnea; ovarium sessile, late ovoideum vel ovoideo-globosum, 1 mm. longum, stylo subapicali, stigmate acute clavato atro-brunneo.

PAPUA: Western Division, Lower Fly River, east bank opposite Sturt Island, common in rain forest, large constricting fig, fruit soft, globose, reddish-brown, ± 1.3 cm. diam., October 1936, *Brass 8065* (TYPE). Central Division, Koitaki, 1500 ft. alt., in forest, tree 24 m., receptacles axillary, ochre, July 1935, *Carr 12778*.

From Diels' description (I have not seen any specimens) I have little doubt that this is identical with the plants described by him as *F. retusa* var. *papuana*. As, however, Diels refers to three of the same specimens under *F. elastica* Roxb., he must have felt doubtful as to the affinity of the plants he had before him. In my opinion the species is not at all closely related to *F. retusa* L. which has very different leaf texture and venation as well as differing in floral characters. The leaves of *F. elastica* more closely approach those of *F. Archboldiana* but the floral differences are considerable. In *F. Archboldiana* the stamen is long exserted from the gamophyllous more or less tubular perianth in which respect the species approaches *F. prolixa* Forst., *F. insignis* Kurz and *F. geniculata* Kurz. *Ficus prolixa* has thinner leaves with definitely unequal lateral nerves and smaller differently coloured receptacles. The other two species differ markedly from *F. Archboldiana* in most characters apart from the stamens.

Ficus regnans Diels in Engl. Bot. Jahrb. **67**: 182 (1935).

PAPUA: Central Division, Rouna, 420 m. alt., climber on rocks in wood on very steep hillside, receptacles axillary, reddish purple when ripe, May 1935, *Carr 12342*.

Ficus rhizophoriphylla King in Jour. Asiat. Soc. Bengal **55**²: 410 (1887).

PAPUA: Western Division, Wuroi, Oriomo River, 30 m. alt., small tree epiphytic on large savannah tree, January–March 1934, *Brass 6018;* Lake Daviumbu, Middle Fly River, in rain forest, large constricting tree, fruit hard, orange-red, September 1936, *Brass 7703;* same locality, large constricting fig of rain-forest canopy, fruit hard, orange-coloured, 10 mm. long, 8 mm. diam., September 1936, *Brass 7759;* Upper Wassi Kussa River, left branch, common tree on river-banks in rain forest, midrib of leaf white, fruit soft, orange-red, compressed, January 1937, *Brass 8616;* Tarara, Wassi Kussa River, occasional in rain forests, large strangling fig, fruit slightly compressed, yellow, "grass" skirt material obtained

from fibrous inner bark of aerial roots, January 1937, *Brass 8712;* Central Division, Koitaki, 480 m. alt., in forest, strangling epiphyte, receptacles axillary, deep orange, June 1935, *Carr 12655;* Koitaki, 450 m. alt., in forest, tree 4.5 m., receptacles axillary, orange, July 1935, *Carr 12893;* Boridi, 1200 m. alt., in forest, tree 42 m., originated as a strangling epiphyte, receptacles axillary, yellowish ochre, September 1935, *Carr 14292.*

Ficus garciniifolia Miq. Ann. Mus. Lugd.-Bat. **3:** 218 (1867).

PAPUA: Central Division, Koitaki, 450 m. alt., on stream bank in open country, tree 12 m., receptacles axillary, yellow-green, April 1935, *Carr 11971.*

A new record for the island, the species being previously known only from Timor.

Ficus retusa L. Mant. 129 (1767).

PAPUA: Western Division, Mabaduan, in swampy rain forest, large constricting fig, ripe fruits purple-black, soft, 9–10 mm. diam., April 1936, *Brass 6549;* Lower Fly River, east bank opposite Sturt Island, rain forest, large strangling fig common on riverbanks, ripe fruit soft, smooth, black, ± 1 cm. diam., October 1936, *Brass 8084;* Central Division, Rona, Laloki River, 450 m. alt., common in rain forests, large constricting species, branches spreading flatly, leaves dark, nerves pale, unripe receptacles about 1 cm. diam., yellow with paler dots, March 1933, *Brass 3592;* Hisiu, in copses in open savannah near sea-shore, tree 15 m., receptacles axillary, when ripe green with a pale pink tinge, February 1935, *Carr 11394;* same locality and habitat, tree 6 m. with many adventitious roots, receptacles axillary, yellow, February 1935, *Carr 11441* — native name, Magi; Veiya, in swamp forest, sea level, tree 15 m., receptacles axillary, green, March 1935, *Carr 11588;* Koitaki, 450 m. alt., in forest, strangling epiphyte, receptacles axillary, red, April 1935, *Carr 12092;* Rouna, 180 m. alt., open savannah land, limbing on rocks, receptacles axillary, green suffused red, June 1935, *Carr 12484.*

Ficus benjamina L. Mant. 129 (1767).

PAPUA: Western Division, Lake Daviumbu, Middle Fly River, in lake-shore rain forest, large constricting fig, fruit green, September 1936, *Brass 7702;* Lower Fly River, east bank opposite Sturt Island, in rain forest, large strangling tree of the canopy layer, branches weak, drooping, fruit pink, hard, October 1936, *Brass 7989;* Central Division, Rouna, N. bank of Laloki River, 210 m. alt., tree 9 m., receptacles axillary, green with whitish warts, May 1935, *Carr 12420;* locality,

habitat and habit as last, receptacles blackish pink when ripe, May 1935, *Carr 12421;* Rouna, S. bank of Laloki River, among rocks, tree 4.5 m., receptacles axillary, bright rose, May 1935, *Carr 12435;* Koitaki, 450 m. alt., in forest, climber, receptacles axillary, deep pinkish purple, June 1935, *Carr 12706.*

Ficus lacor Buch.-Ham. in Trans. Linn. Soc. Lond. **15:** 150 (1827).

Ficus infectoria Roxb. Hort. Bengal. 66 (1814), nomen, Fl. Ind. **3:** 551 (1832), non Willd.

PAPUA: Central Division, Kanosia, in mangrove swamps, tree 15 m., receptacles axillary, pink, purple and soft when mature, January 1935, *Carr 11017;* Rouna, 210 m. alt., in open savannah land, shrub 3 m., receptacles axillary, bright pink, May 1935, *Carr 12422.*

Ficus stipulosa (Miq.) Miq. Ann. Mus. Lugd.-Bat. **3:** 287 (1867).

PAPUA: Central Division, Rouna, 390 m. alt., open country, tree 15 m. tall, receptacles axillary, purple when ripe, July 1935, *Carr 12814.*

This species is another addition to the New Guinea *Ficus* list, it having been recorded previously only from the Philippines.

Ficus glabella Bl. Bijdr. 452 (1825).

PAPUA: Western Division, Lower Fly River, east bank opposite Sturt Island, in rain forest, large constricting trees spreading long branches over river, young fruit green speckled with pink, October 1936, *Brass 8071.*

TERRITORY OF NEW GUINEA: Morobe Distr., near Andarova village, in forest on mountain side, 1500 m. alt., tree, sterile, December 1936, *Blackwood 126* — vern. name, yefeva.

Ficus pilosa Reinw. in Bl. Bijdr. 446 (1825).

Ficus chrysochlamys Lauterb. & K. Schum. Fl. Deutsch. Schutzgeb. Südsee 274 (1901).

PAPUA: Western Division, Mabaduan, common on granite coast, large constricting fig to 20 m. high, leaves glossy above, midrib white, receptacle small, beaked, April 1936, *Brass 6479;* Lake Daviumbu, Middle Fly River, in rain forest on shore of lake, large constricting fig, leaf-nerves pale, August 1936, *Brass 7481;* Lower Fly River, east bank opposite Sturt Island, common on banks of river in rain forest, large low-spreading tree, fruit in pairs one ripening long before the other, soft, purple-black, 3 cm. long, 2 cm. diameter, October 1936, *Brass 8075;* Upper Wassi Kussa River, left branch, in rain forest, tree 15 m. overhanging river, leaf-nerves white, fruit hard, red flecked with white,

January 1937, *Brass 8615;* Central Division, Kanosia, 60 m. alt., in secondary forest, spreading tree up to 18 m., receptacles axillary, orange when ripe, February 1935, *Carr 11062*.

Ficus chrysochlamys Lauterb. & K. Schum. is, in my opinion, quite incorrectly referred by Diels to *F. Forstenii* Miq. which, at any rate as regards the type form, does not appear to occur in New Guinea.

Ficus patellifera Warb. in K. Schum. & Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. Südsee 241 (1905).

PAPUA: Central Division, Dieni, Ononge Road, 500 m. alt., rain forest, large constricting tree, leaves flat with recurved tip and pale nerves, April 1933, *Brass 3857*.

This species resembles closely certain forms of *F. Forstenii* Miq. and may yet prove to be a variety of that species.

Ficus sp.

PAPUA: Central Division, Mafulu, 1250 m. alt., planted in villages, very large dense-foliaged spreading tree, leaves dark, smooth, midrib white, receptacles red when ripe, September–November 1933, *Brass 5433*.

I have not been able to identify this with any native or exotic fig. In view of the pantropical distribution of sect. *Urostigma* and the poor material of the above collection, I think it best left undetermined.

Sect. SYCIDIUM

Ficus mangiferifolia Lauterb. & K. Schum. Fl. Deutsch. Schutzgeb. Südsee 275 (1901).

PAPUA: Central Division, Rona, Laloki River, 450 m. alt., common in rocky river bed, tree 3–5 m., branching from near base, young leaves yellow-green, terminal bud red, receptacles yellow, tinged red with pale tubercles, 1.3–1.4 cm. diam., March 1933, *Brass 3588;* same locality, 500 m. alt., rocky creek-bed in rain forest, tree 4 m., fruit red spotted with yellow, soft, about 1.5 cm. long and in diam., February 1936, *Brass 6204;* Rouna (= Rona), 210 m. alt., in an island in the Laloki River, tree 12 m., receptacles axillary, pinkish orange, May 1935, *Carr 12416*.

TERRITORY OF NEW GUINEA: New Britain, between Baining Mts. and Toma, *Bateson 128;* Möwehafen, sea level, tropical forest, tree, June 1937, *Blackwood 301.* — vern. name, "imyi" or "imi."

Ficus dichroa Summerh. in Jour. Arnold Arb. **10:** 147 (1929).

PAPUA: Central Division, Kanosia, sea level, in secondary forest, tree 4.5 m., receptacles axillary, single or paired, dull red, February 1935, *Carr 11208*.

Ficus subulata Bl. Bijdr. 460 (1825).

PAPUA: Central Division, Mafulu, 1250 m. alt., forest, small epiphytic tree, receptacles orange-red, 1.1–1.2 cm. diam., September–November 1933, *Brass 5209;* Bella Vista, 1450 m. alt., forest below Oak associations, small spreading tree or large bush 3 m. high, receptacles orange-red, November 1933, *Brass 5442;* Veiya, sea level, in forest, forming dense undergrowth and climbing up trees, receptacles axillary, dark red when ripe, March 1935, *Carr 11690;* Koitaki, 450 m. alt., open place by stream, tree 6 m., receptacles axillary, bright orange-red, April 1935, *Carr 11927;* Boridi, 1050 m. alt., forest, climber, receptacles axillary, red, October 1935, *Carr 14732;* North-Eastern Division, Kokoda, 360 m. alt., forest, small tree, September 1933, *Cheesman 90.*

Ficus philippinensis Miq. in Hook. Lond. Jour. Bot. **7**: 435 (1848).

Ficus Decaisneana Miq.; Summerhayes in Jour. Arnold Arb. **14**: 62 (1933).

PAPUA: Western Division, Wuroi, Oriomo River, January–March 1934, *Brass 5889;* Central Division, Koitaki, 450 m. alt., bank of stream, tree 12 m., receptacles axillary, ochre-yellow speckled brown, April 1935, *Carr 11906;* Rouna, 420 m. alt., open savannah land, tree 4.5 m., receptacles axillary, pale pinkish olive with an apical green ring, laxly speckled pale brown, May 1935, *Carr 12331;* North-Eastern Division, Kokoda, 360 m. alt., forest, tree 18 m., May 1933, *Cheesman 26;* same locality and altitude, clearing near police-station, tree 15 m., June 1933, *Cheesman 53;* as last, in clearing, tree 18 m., August 1933, *Cheesman 86.*

TERRITORY OF NEW GUINEA: Kelel, 200 m. alt., by mountain stream, tree, September 1907, *Schlechter 16508.* New Britain, Gazelle Peninsula, between Kabakada mission and Vunairima, large tree, December 1934, *Waterhouse 898* — vern. name, "Naqala."

Diels completely omits this species from his account of the genus, but the specimens cited above agree well with many from the Philippines and elsewhere.

Ficus hylobia Diels in Engl. Bot. Jahrb. **67**: 186 (1935).

PAPUA: Central Division, Lala River, 1500 m. alt., forest, tree 12 m., receptacles axillary, green, red inside, February 1936, *Carr 15711;* same locality and habitat, tree 9 m., receptacles axillary, green, February 1936, *Carr 15797.*

Dissections of receptacles of two of the three gatherings cited by Diels revealed female flowers only. This, in conjunction with the floral structure and general appearance, suggests that sect. *Sycidium* is the correct position of this species.

Ficus androbrota Summerh. in Jour. Arnold Arb. **10:** 143 (1929).

PAPUA: Western Division, Gaima, Lower Fly River, east bank, common about rain-forest edges, erect tree 6–8 m. high, leaf-nerves pale, fruit 1.1–1.2 cm. diam., November 1936, *Brass 8298;* Wassi Kussa River, Tarara, at margin of rain forest, small tree, fruits soft, purple-black, December 1936, *Brass 8548.*

Ficus gibbosa Bl. Bijdr. 466 (1825).

PAPUA: Western Division, Lower Fly River, east bank opposite Sturt Island, on river bank in rain forest, thick foliaged tree 5 m. high, ripe fruit soft, red, depressed-globose, 1.5–1.7 cm. diam., October 1936, *Brass 8077;* Central Division, Rona, Laloki River, 450 m. alt., common in gully rain forest associations, tree 10–12 m., long flatly spreading branches, receptacles soft dark red, 1.5 × 1.2 cm., March 1933, *Brass 3572;* Mafulu, Auga River, 580 m. alt., among rocks on river bank, small grey-barked tree 3 m. high, leaves stiff, pale with whitish midrib and nerves, receptacles slightly scabrous, orange-red, 1.2–1.4 cm. diam., November 1933, *Brass 5497;* Kanosia, at edge of mangrove swamp, tree 9 m., receptacles axillary, golden-yellow, February 1935, *Carr 11529;* Rouna (= Rona), 210 m. alt., forest on N. bank of Laloki River, tree 4.5 m., receptacles green with reddish brown spots, May 1935, *Carr 12413;* Rouna, 210 m. alt., open savannah land, tree 4 m., receptacles golden-yellow, June 1935, *Carr 12486;* Koitaki, 450 m. alt., forest, tree 24 m., receptacles red, July 1935, *Carr 12876.*

The New Guinean plants of this affinity are, I think, best referred to *F. gibbosa* Bl. *Ficus tinctoria* Forst. f., to which Diels reduces *F. gibbosa,* is a Pacific Island species not occurring farther west than the Bismarck Archipelago.

Ficus leptodictya Diels in Engl. Bot. Jahrb. **67:** 196 (1935).

PAPUA: Central Division, Boridi, 1350 m. alt., forest, tree 12 m., receptacles dark red when mature, November 1935, *Carr 14799.*

Ficus ochrochlora Ridl. in Trans. Linn. Soc. Lond. Ser. 2, Bot. **9:** 148 (1916).

PAPUA: Western Division, Palmer River, 2 miles below junction of Black River, 100 m. alt., tree 10 m., fruit green, June 1936, *Brass 6954;* same locality, common in second-growth forests on sandy river banks, tree 5 m., receptacles green with brown tubercles, solitary and sessile in axils, about 2.3 cm. diam., July 1936, *Brass 7287;* Central Division, Mafulu, 1250 m. alt., abundant on banks of small stream, tree up to 6–7 m. with spreading branches, receptacles reddish-brown, slightly

warted, about 1.5 cm. diam., September–November 1933, *Brass 5337;* Brown River, 90 m. alt., on bank, tree 6 m., receptacles green, August 1935, *Carr 12946.*

Obviously closely allied to *F. Gazellae* Engl. but with much larger sessile receptacles with numerous scattered bracts.

Ficus macrorrhyncha Lauterb. & K. Schum. in Fl. Deutsch. Schutzgeb. Südsee 277 (1901).

Papua: Central Division, Mafulu, 1100 m. alt., tall forest of lower levels, substage tree 10 m., immature receptacles reddish, about 1 cm. diam., September–November 1933, *Brass 5376;* Isuarava, 1350 m. alt., forest, tree 4 m., receptacles dull pink, February 1936, *Carr 15529.*

Territory of New Guinea: Kani Mts., 1000 m. alt., in woods, January 1908, *Schlechter 17225.*

In my opinion Diels is quite wrong in reducing this species to *F. celebica* Bl., which has leaves with different venation, base and indumentum, and smaller and differently shaped receptacles. The Schlechter specimen is cited by Diels under *F. Caroli* Diels but appears to be an almost glabrous form of *F. macrorrhyncha.*

Ficus trachypison K. Schum. in Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 280 (1901).

Ficus pteleiphylla S. Moore in Jour. Bot. **61,** suppl. 49 (1923).

Papua: Western Division, Wuroi, Oriomo River, 5 m. alt., in river-bank forest, loosely branched, erect tree, 10 m. high, receptacles orange-red, about 1.2 cm. diam., January 1934, *Brass 5771;* same locality, 5–10 m. alt., rain forest fringing river, slender tree 15 m., sap not milky, leaves dark and shining above, receptacles pale yellow, about 1.4 cm. diam., January 1934, *Brass 5881;* Central Division, Koitaki, 450 m. alt., open country, tree 4.5 m., receptacles deep golden-yellow, April 1935, *Carr 12030;* same locality and altitude, open savannah land, shrub 1 m., fruits green, May 1935, *Carr ? 12266;* as last, forest, tree 18 m., receptacles green, tipped darker, July 1935, *Carr 12779;* Boridi, by Hovea River, forest, 1050 m. alt., tree 6 m., receptacles yellow, October 1935, *Carr 14736;* same locality and altitude, secondary forest, 4.5 m., receptacles orange, November 1935, *Carr 14934;* Isuarava, 1050 m. alt., secondary forest, tree 9 m., receptacles greenish-orange, February 1936, *Carr 15788.*

The type of *F. pteleiphylla* S. Moore agrees well with *F. trachypison* in vegetative and floral characters, the most obvious difference being that the leaf-venation is much more distinct on the under surface. Judging from other specimens this is merely a matter of preservation.

Ficus hystricicarpa Warb. in K. Schum. & Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. Südsee 244 (1905).

PAPUA: Central Division, Mt. Tafa, 2400 m. alt., brushy roadside clearing, a few examples, small erect branched or unbranched shrub to 50 cm. high, receptacles dark green, orifice red, September 1933, *Brass 5041;* Boridi, 1500 m. alt., forest, shrub 2.5 m., receptacles on very short lateral branches, green, September 1935, *Carr 13335;* Lala River, 1650 m. alt., forest, shrub 3 m., receptacles bright red, December 1935, *Carr 14051;* Eastern Division, Ebomi Island, Samarai, sea level, tree 9 m., November 1933, *Cheesman 132.*

Ficus Caroli Diels in Engl. Bot. Jahrb. **67:** 200 (1935).

PAPUA: Central Division, Mt. Tafa, 2400 m. alt., in landslip shrubbery, common, bush 1.2–1.5 m., young leaves brown beneath, mature stiff, scabrid, receptacles solitary, hard, pale brown, 1.3–1.5 cm. diam., May–September 1933, *Brass 5098;* Boridi, 1410 m. alt., secondary forest, tree 4.5 m., receptacles dark red, September 1935, *Carr 13304;* Alola, 1860 m. alt., forest, tree 9 m., receptacles on very short lateral branches, deep red when mature, December 1935, *Carr 13656* (? 15656); Boridi, 1350 m. alt., forest, tree 4.5 m., receptacles green, September 1935, *Carr 14211;* Boridi, 1200 m. alt., forest, tree 9 m., receptacles pale greenish, October 1935, *Carr 14342;* Boridi, 1410 m. alt., secondary forest, shrub 2 m., receptacles deep blackish-purple, November 1935, *Carr 14866.*

Ficus phaeosyce Lauterb. & K. Schum. Fl. Deutsch. Schutzgeb. Südsee 276 (1901).

PAPUA: Central Division, Mafulu, 1500 m. alt., forest, tree 6 m., Dec. 1933, *Cheesman 130.*

Ficus Branderhorstii Diels in Engl. Bot. Jahrb. **67:** 201 (1935).

PAPUA: Western Division, Upper Wassi Kussa River, left branch, scattered along gullies in savannah forest, low tree 3–4 m., fruit immature, January 1937, *Brass 8655.*

This specimen is less hairy than the type and the leaves have fewer lateral nerves but the general facies is the same and the two agree in floral characters.

Ficus Armiti King in Jour. Asiat. Soc. Bengal, **55**[2]: 404 (1887).

PAPUA: Central Division, Mafulu, 1250 m. alt., in Oak forests, scandent with slender branches spreading flatly from supporting tree trunk, leaves pale, receptacles solitary, smooth, yellow or orange-yellow, September–November 1933, *Brass 5293.*

Ficus hololampra Diels, l.c. 201.

PAPUA: Western Division, Lower Fly River, east bank opposite Sturt Island, rain forest, common on riverbanks, large independent canopy-tree, stem spur-buttressed, bark brownish-black, rough, fruit depressed-globose, orange-yellow flecked with green, October 1936, *Brass 8079.*

Ficus chaetophora Warb. in K. Schum. & Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. Südsee 246 (1905).

Ficus adenosperma Summerh. in Jour. Arnold Arb. **10**: 143, 206 (1926), non Miq.

PAPUA: Western Division, Palmer River, 2 miles below junction of Black River, 100 m. alt., chief component of seral forests of sandy river-banks and islands of stream, tree 8–10 m. with slightly drooping branches, receptacles soft, green, ± 1.7 cm. diam., June 1936, *Brass 6953;* Lower Fly River, Sturt Island, rain forest, spreading tree 8–10 m., in small pure stands on river bank, latex yellow-brown, leaf-nerves white, fruit green, up to 1.2 cm. diam., October 1936, *Brass 8192;* Central Division, Mafulu, 580 m. alt., common along river bottom, tree 15–18 m. with flat spreading branches, leaves pale, nerves whitish, receptacles green, about 1.5 cm. diam., October 1933, *Brass 5269;* Veiya, sea level, riverside swamp forest, tree 4.5 m., receptacles green, March 1935, *Carr 11598;* same locality, secondary forest, tree 4.5 m., receptacles brown-purple with greenish spots, March 1935, *Carr 11737;* Rouna, 240 m. alt., open savannah land, tree 4.5 m., receptacles green, June 1935, *Carr 12483;* Brown River, 90 m. alt., river bank, tree 4.5 m., receptacles green, August 1935, *Carr 12945.*

TERRITORY OF NEW GUINEA: New Britain, Malabungi Mission, in secondary jungle, *New Guinea Dept. Agric. A 18.*

Ficus adenosperma Miq., to which I referred some specimens of this species collected by Brass in 1926, differs from *F. chaetophora* in the different indumentum of the stems, in the midribs of the leaves being adpressed-hairy beneath and in minor floral details. The species are evidently closely allied.

Ficus pycnoneura Lauterb. & K. Schum. Fl. Deutsch. Schutzgeb. Südsee 275 (1901); Diels in Engl. Bot. Jahrb. **67**: 187 (1935).

PAPUA: Central Division, Koitaki, 450 m. alt., wood by stream, shrub 2 m., leaves green, nerves rose-red beneath, receptacles shiny green, April 1935, *Carr 11951.*

Diels places *F. pycnoneura* and his new species *F. trichocerasa,* together with *F. aruensis* King, in sect. *Urostigma* where they constitute

one of his four subgroups. Except that *F. pycnoneura* was originally referred to this section, I cannot see on what grounds these species should be included in it, especially as Diels himself says that *F. pycnoneura* is allied to *F. adenosperma* Miq. *Ficus aruensis* appears to me to have nothing to do with the other species and is referred to quite a different section (*Neomorphe*) by King. I have examined material of both the New Guinea species, including the type specimens, and I can find only male and gall flowers in any of the receptacles examined. I have observed no female flowers and indeed all the stigmas seen are of a reduced type found generally in gall flowers. Apart from this, the floral characters are not those of sect. *Urostigma* but rather those of sect. *Sycidium*, to which I believe both species, as well as *F. endochaete* (see below), should be referred. *Ficus xanthoxyla* Summerhayes which, following suggestions made by myself, is placed by Diels in sect. *Eusyce*, is evidently allied to *F. pycnoneura* and should also be included in sect. *Sycidium*.

Ficus endochaete Summerhayes, sp. nov.; affinis *F. pycnoneurae* Lauterb. & K. Schum. et *F. trichocerasae* Diels, a quibus ramulis junioribus ± patentim molliter pilosis, foliis anguste lanceolatis basi subrotundatis subtus costa et nervis densius indutis, receptaculis bracteis prope apicem pseudo-annulatim dispositis mespili ad instar facile distinguenda.

Arbor parva. Ramuli graciles, juniores dense ± patentim molliter griseo-pilosi, demum glabrescentes, cortice rubro-brunneo vel griseo-brunneo leviter ruguloso obtecti. Folia breviter petiolata, anguste lanceolata, apice sensim acuminata, basi rotundata vel subrotundata, usque ad 11 cm. longa et 2 cm. lata, marginibus leviter recurvatis, costa et nervis supra impressis subtus prominentibus, nervis primariis utrinsecus 11–15 infimis e costa angulo fere recto superioribus e costa angulo 50°–60° exortis curvatim adscendentibus prope marginem arcuatim conjunctis, siccitate discoloria, supra juventute adpresse pilosa demum (costa longiuscule adpresseque pilosa excepta) glabra, subtus pallidiora costa et nervis dense adpresseque pilosa ceterum pubescentia; petiolus fere teres, supra leviter canaliculatus, 8–12 mm. longus, ± dense molliter pilosus; stipulae lanceolatae, acuminatae, circiter 1 cm. longae, costa dorsaliter fulvido-pilosa excepta glabrae. Receptacula axillaria, solitaria, pedunculata, sphaeroidea, 8–9 mm. longa, 9–10 mm. diametro, extra breviter pubescentia, intus inter flores dense brunneo-setulosa, bracteis 1–2 infimis basi receptaculi sitis ceteris prope apicem receptaculi pseudo-annulatim dispositis subcarnosis obtusis, ostiolo vix dis-

tincto bracteis leviter prominentibus; pedunculus ebracteatus, gracilis, 7–13 mm. longus, sparse pubescens. Flores masculi cum femineis cecidiophoris in eodem receptaculo inclusi, prope ostiolum dispositi, sessiles; perianthii segmenta 3, distincta, oblonga vel oblanceolata, obtusa, circiter 2 mm. longa, glabra, rubro-brunnea, stamen singulum includentia. Flores feminei cecidiophori sessiles; perianthii segmenta 2–4, iis florum masculorum similia sed lineari-oblonga vel linearia; ovarium ovoideum vel ellipsoideum, stylo laterali vel subapicali stigmate truncato-clavato coronato. Flores feminei non visi.

PAPUA: Central Division, Mt. Tafa, 2400 m. alt., small tree on bank of a stream in forest, leaves pale, receptacles solitary, green, May–September 1933, *Brass 4913*.

From the vegetative and floral characters this species is evidently allied to *F. pycnoneura* Lauterb. & K. Schum. and *F. trichocerasa* Diels, from which it differs most obviously in the very narrow lanceolate leaves, these being elliptical, obovate or broadly oblanceolate in its two relatives. *Ficus trichocerasa* has a number of bracts scattered on the surface of the receptacle, but in *F. endochaete* these are mostly aggregated around the ostiole forming a sort of discontinuous rim and producing an appearance reminiscent of a medlar.

Ficus charadrophila Summerh. in Jour. Arnold Arb. **10**: 152 (1929).

PAPUA: Western Division, Palmer River, 1 mile below junction of Black River, shrub or small tree seldom more than 1 m. high, crown flat, 3–4 m. diam., branches very tough, smooth, purple-black, June 1936, *Brass 6949*.

Ficus Bismarckiana Diels in Engl. Bot. Jahrb. **67**: 206 (1935).

PAPUA: Central Division, Koitaki, 450 m. alt., wood by stream, tree 6 m., receptacles green, tipped dark green, June 1935, *Carr 12582;* Isuarava, 1200 m. alt., secondary forest, tree 9 m., receptacles brownish-olive, February 1936, *Carr 15609*.

TERRITORY OF NEW GUINEA: Admiralty Islands, March 1875, *Moseley*.

Ficus xanthosyce Summerh. in Jour. Arnold Arb. **10**: 144 (1929).

PAPUA: Central Division, Mafulu, 1250 m. alt., forest second growths, common compact tree of erect branching habit, about 5 m. high, ripe receptacles purple, soft and palatable, September–November 1933, *Brass 5243*.

Ficus duriuscula King in Ann. Bot. Gard. Calc. **1**: 155, t. 195 (1888).

PAPUA: Western Division, Lower Fly River, east bank opposite Sturt

Island, rain forest, common on ground occasionally flooded, substage tree 14–16 m., fruit hard, in numerous small fascicles on stem, yellow brown, erect, October 1936, *Brass 8001;* Central Division, Rona, Laloki River, 450 m. alt., common in shelter of rocks on savannah hillside, tree 3–4 m., receptacles occasionally axillary but almost all fasciculate on trunk and branches, 1.5 × 1.3 cm., red, soft when ripe, March 1933, *Brass 3567;* same locality and altitude, light rain forest on hillside, small tree 5 m. high, leaves shining above, receptacles in fascicles on stem and main branches, broadly pyriform, about 2.5 cm. diam., reddish brown with pale yellow dots, March 1933, *Brass 3619;* near Rouna Falls, 270 m. alt., forest on steep rocky hillside, tree 4.5 m., receptacles on short branches, deep cream suffused rose-red at apex, May 1935, *Carr 12358;* North-Eastern Division, Kokoda, 360 m. alt., forest, small tree, September 1933, *Cheesman 91.*

Ficus muriculata Miq. in Zoll. Syst. Verz. 93, 98 (1854).

Ficus longepedunculata Rechinger; Diels in Engl. Bot. Jahrb. **67:** 208 (1935), non Elmer.

PAPUA: Western Division, Tarara, Wassi Kussa River, in village clearing, one tree 6 m. high, midrib and nerves red below, fruit clustered on main branches, brown, depressed, secreting a thick yellow latex, January 1937, *Brass 8749;* Central Division, Veiya, sea-level, forest, tree 12 m., receptacles on very short cauline branches or axillary, very pale green, March 1935, *Carr 11728;* North-Eastern Division, Kokoda, 360 m. alt., forest, April 1933, *Cheesman 2,* May 1933, *Cheesman 22.*

I am not quite certain of the relationship of this to *F. copiosa* Steud. which is very similar in many respects.

Sect. COVELLIA

Ficus septica Burm. f. Fl. Ind. 226 (1768); Diels in Engl. Bot. Jahrb. **67:** 194 (1935).

Ficus casearia F. Muell. ex Benth.; Summerh. in Jour. Arnold Arb. **10:** 148 (1929).

PAPUA: Western Division, Daru Island, plentiful in low secondary growth on old garden clearings, shrub or small tree, fruit white, March 1936, *Brass 6243;* Lake Daviumbu, Middle Fly River, rain forest, shrub in forest borders or tree 5–6 m. in secondary growth, fruit white, August 1936, *Brass 7558;* Central Division, Rona, Laloki River, 450 m. alt., in shelter of rocks on savannah, tree 3–4 m., no latex, receptacles greenish white, ribbed, up to 2.5 cm. diam., March 1933, *Brass*

3569; Mafulu, 1250 m. alt., plentiful in regrowth brush, bush or small tree 2–3 m., receptacles in axillary pairs, pale green, September–November 1933, *Brass 5412;* Mafulu, 1200 m. alt., on grass slope in forest, young trees 2 m. high, Dec. 1933, *Cheesman 131;* Kanosia, 15 m. alt., under *Hevea,* tree 4.5 m., receptacles axillary, pale green, February 1935, *Carr 11530;* Boridi, 1110 m. alt., secondary forest, tree 5 m., receptacles green, spotted brown, October 1935, *Carr 14661;* Isuarava, 1050 m. alt., secondary forest, tree 7.5 m., receptacles light green, February 1936, *Carr 15746.*

Territory of New Guinea: Minjem Thor, May 1907, *Schlechter 16091* (cited by Diels under *F. tinctoria* Forst. f.); Morobe Distr., Andarova, 1500 m. alt., forest on mountain side, small tree, January 1937, *Blackwood 176;* Duke of York Island (between New Britain & New Ireland), *Bradtke 274;* New Britain, Möwehafen, sea-level, tropical rain forest, June 1937, *Blackwood 314* — vern. name, "Watiri."

I do not understand on what grounds Diels transferred this species from sect. *Covellia* (in which it was placed by King under the name of *F. leucantotoma* Poir.) to sect. *Sycidium.* King's plate shows the gall and female flowers to possess the typical structure of sect. *Covellia,* while specimens from New Guinea possess identical floral structure. It is interesting to note that although all the specimens I have seen from Malaya and the mainland of New Guinea possess strictly axillary receptacles, there are some in the Kew Herbarium from the Admiralty Islands and from the New Hebrides in which some of the receptacles are borne on leafless cauline branches such as are found generally in sect. *Covellia.* In other respects these specimens agree perfectly with material bearing axillary receptacles.

Ficus formosa Summerhayes, sp. nov.; inter species sectionis foliis obovatis inferne subvelutinis, receptaculis axillaribus solitariis, florum cecidiophororum perianthii segmentis liberis apice subspathulatis subulato-acuminatis valde distincta.

Arbor formosa, multiramosa, 16 m. alta; ramuli crassiusculi, longitudinaliter rugulosi, juventute molliter villosuli, demum glabri cortice cinereo-brunneo obtecti, cicatricibus stipularum et foliorum delapsorum notati. Folia breviter petiolata, obovata, apice breviter caudato-acuminata, inferne cuneatim angustata, basi ipsa aequaliter subcordata, 9–14 cm. longa, 5–8 cm. lata, viva pallida, siccitate brunnescentia, supra costa pubescente excepta glabra, subnitentia, subtus praesertim costa et nervis subvelutino-villosula, costa et nervis supra impressis subtus prominentibus, nervis lateralibus utrinsecus 9–13 e costa angulo 65°–85°

exortis parallelis curvatis juxta marginem arcuatim conjunctis, nervis secundariis et tertiariis distinctis, mesophyllo subtus sub lente minute elevato-puncticulato; petiolus 1–2 cm. longus, supra canaliculatus, villosulus; stipulae 1–2 cm. longae, extra villosulae. Receptacula axillaria, solitaria, breviter pedunculata, valde depresse globosa, usque ad 3 cm. longa et 4 cm. diametro, extra sparse pubescentia, intus inter flores hyalino-setosa, pedunculo circiter 5 mm. longo quam receptaculo magis piloso apice bracteis tribus brevissimis truncatis instructo, ostiolo vix prominente bracteis numerosis imbricatis levissime adscendentibus instructo. Flores masculi prope ostiolum siti, sessiles; perianthii segmenta 3–4, libera vel basi ± connata, lanceolato-ligulata, acuta, 3–3.5 mm. longa, stamen superantia, glabra, rubro-brunnea; stamen 1, anthera apiculata 1.5 mm. longa. Flores feminei cecidiophori sessiles vel usque ad 2 mm. pedicellati; perianthii segmenta 5, libera, ex ungue longa angustissima subspathulata, apice subulato-acuminata, tota 3–5.5 mm. longa; ovarium stipitatum, stipite usque ad 3.5 mm. longo, ellipsoideum vel obovoideum, 1–2 mm. longum, atro-brunneum, stylo infra-apicali, stigmate breviter infundibuliformi. Flores feminei non visi.

PAPUA: Central Division, Mafulu, 1250 m. alt., in lower primary forest, much branched tree, 16 m. high, leaves pale, receptacles solitary in axils, up to 4 × 3 cm., September–November 1933, *Brass 5346*.

This species shows such an exceptional combination of characters that it is difficult to place it with confidence in any of the sections proposed by King. In general appearance of the vegetative parts and receptacles it resembles those species of sect. *Covellia* with axillary receptacles, while the infundibuliform stigmas of the gall-flowers are quite similar to those in many species of this section. The perianths of both male and gall flowers are, however, very unlike those usually found in sect. *Covellia*, consisting of several almost or quite free parts, and being much more reminiscent of the perianth in many species of sect. *Sycidium*. In the gall flowers each segment has a long narrow claw with a spathulate lamina at the apex. Corner* points out that in *F. cunia* Ham. the perianth segments in the female flowers are only united at the base. This species, however, has geocarpic receptacles and is in other respects very dissimilar from *F. formosa*.

Ficus hylophila Lauterb. & K. Schum. Fl. Deutsch. Schutzgeb. Südsee 283 (1901).

PAPUA: Western Division, Oriomo River, Wuroi, 10 m. alt., solitary example at river landing place clearing, apparently planted, small bushy

*Jour. Roy. Asiat. Soc. Malay. Branch 11: 21 (1933).

tree 4 m. high, receptacles yellow-green, sweet and palatable, January–March 1934, *Brass 5792;* Central Division, Dieni, Ononge Road, 500 m. alt., common in rain forests, slender tree 5 m., leaves dark and glossy, receptacles clustered on trunk, 1 cm. long, 1.2 cm. diam., florets purple, April 1933, *Brass 3828;* Mafulu, 1250 m. alt., common in lower forests, tree 5–8 m., leaf midrib and nerves whitish, receptacles clustered on lower trunk, numerous, pyriform, November 1933, *Brass 5506.*

Ficus Hahliana Diels in Engl. Bot. Jahrb. **67:** 211 (1935).

PAPUA: Western Division, Fly River, 528 mile camp, 80 m. alt., rain forest secondary growth, slender, sparsely branched tree 6 m. high, fruit costate at apex, in small clusters on stem below branches, May 1936, *Brass 6755.*

This agrees with Diels' description in the indumentum, shape and size of the leaves, the number of lateral nerves, the type of inflorescence, the setose inside of the receptacle and the hairy styles. It differs in the shape of the base and the hairy upper surface of the leaves, the length of the peduncles and the slightly smaller female flowers.

Ficus Bernaysii King in Jour. Asiat. Soc. Bengal **55**[2]: 406 (1887).

PAPUA: Central Division, Isuarava, 1350 m. alt., secondary forest, tree 6 m., receptacles on short, very dense lateral branches, brown, February 1936, *Carr 15517.*

Ficus grandis King in Ann. Bot. Gard. Calcutta **1:** 170, t. 214 (1888).

PAPUA: Central Division, Rona, Laloki River, 450 m. alt., rare in shelter of rocks on open savannah, stiffly branched small tree 4 m. high with very slightly fissured bark, leaves stiff, white-flecked on upper surface, receptacles clustered on trunks and along branches, depressed pyriform, 3.5 cm. long, 4–5 cm. diam., yellow-green with white flecks and small brown pointed tubercles, rather palatable, March 1933, *Brass 3551;* Kanosia, sea level, in marshy forest, tree 4.5 m., receptacles on very short cauline branches, February 1935, *Carr 11316;* Koitaki, 450 m. alt., in wood by stream, tree 6 m., receptacles in short branched cauline inflorescences, cream, suffused dull red towards the base, April 1935, *Carr 11949.*

Ficus setistyla Warb. in K. Schum. & Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. Südsee 248 (1905).

Ficus grandis Diels in Engl. Bot. Jahrb. **67:** 214 (1935), partim.

PAPUA: Western Division, Dagwa, Oriomo River, 40 m. alt., forest patches in limestone sink-hole, small tree, branchlets hollow, receptacles

in small clusters on trunk and main branches, soft, warty, February 1934, *Brass 5967;* Daru Island, at edge of rain forest, spreading low tree 6 m. high, fruit in numerous fascicles on trunk and main branches, flattened, yellow-green, April 1936, *Brass 6440;* Lake Daviumbu, Middle Fly River, occasional in secondary rain forest, low cauliflorus tree, 4.5 m., fruit green, warted compressed, about 4 cm. diam., September 1936, *Brass 7740;* Central Division, Kubuna, 100 m. alt., riverbank in rain forest regrowths, tree 6 m., branches hollow, receptacles in small clusters on trunk, up to 5 cm. diam., green, November 1933, *Brass 5605;* Veiya, sea level, riverside forest, tree 12 m., receptacles in very short dense cauline branches, olive-green laxly speckled brown, eaten by natives, March 1935, *Carr 11640* — vern. name, "Nananu."

In his account of the New Guinea figs Diels includes this under *F. grandis* King. Examination of material of both species satisfies me that they should be separated as distinct species. *Ficus setistyla* differs in the leaves being much hairier, in the base being usually markedly cordate with often unequal sides and in the much shorter petiole. The stigmas of the gall flowers are peltate whereas those of *F. grandis* are infundibuliform.

Ficus pachythyrsa Diels in Engl. Bot. Jahrb. **67:** 215 (1935).

PAPUA: Western Division, Lower Fly River, east bank opposite Sturt Island, rain forest, substage tree on drier soils, receptacles crowded at ends of thick spreading branches up to 50 cm. long on lower stem, green speckled with brown, about 2 cm. diam., October 1936, *Brass 8144.*

This specimen agrees well with Diels' description except the hairs on the leaf nerves are not closely but only loosely adpressed.

Ficus arfakensis King in Ann. Bot. Gard. Calcutta, **1:** 104, t. 133 (1888).

PAPUA: Central Division, Dieni, Ononge Road, 500 m. alt., rain forest, slender tree 10 m., fruiting branches on lower trunk, up to 1 m. long, receptacles pale brown, 1.4 cm. long, 1.6 cm. diam., April 1933, *Brass 3832;* Mafulu, 1250 m. alt., substage of forest on limestone country, tree 7–8 m., leaves thin, brown hirsute beneath, fruiting branches near base of trunk, 1.5 m. long, half their length resting on the ground, October 1933, *Brass 5227;* Koitaki, 450 m. alt., forest, tree nearly 4 m., receptacles on cauline branches, brown, April 1935, *Carr 12025;* Garabinumu, 300 m. alt., forest, tree 6 m., receptacles on basal branches up to 3 m. long, green spotted biscuit, August 1935, *Carr 12910;* Yodda River below Isuarava, 1050 m. alt., secondary forest,

tree 6 m., receptacles on long lateral branches, red-brown speckled cream, February 1936, *Carr 15489.*

Ficus myriocarpa Miq. Ann. Mus. Lugd.-Bat. **3:** 230 (1867).

PAPUA: Western Division, Palmer River, 2 miles below junction of Black River, 100 m. alt., common in older second growth forests on river flood-plains, tree 10–12 m., receptacles on diffuse leafless branches from trunks and main limbs, soft, red, 1.5 cm. diam., July 1936, *Brass 7328;* Central Division, Bella Vista, 1450 m. alt., common in regrowth forest, densely foliaged spreading tree about 12 m. high, immature receptacles on long pendent panicles, November 1933, *Brass 5441;* Koitaki, 450 m. alt., forest, tree 15 m., receptacles on basal branches nearly 2 m. long, orange-red, July 1935, *Carr 12807;* Brown River, 90 m. alt., river bank, tree 4.5 m., geocarpic, receptacles on long basal branches, dull red, August 1935, *Carr 12950;* Boridi, 1110 m. alt., forest, tree 9 m., receptacles on long lateral branches sometimes trailing along the ground, dull red, October 1935, *Carr 14664.*

TERRITORY OF NEW GUINEA: Morobe Distr., above Eku, 1500 m. alt., forest on mountain side, tree, fruit branches hang straight from trunk, *Blackwood 224.* Vern. Names: — wikwa (Nauti), gwaip (Mauki).

Ficus conora King in Ann. Bot. Gard. Calcutta, **1:** 103, t. 131 (1888).

Ficus brachiata Ridley in Gibbs, Phytogeogr. & Fl. Arfak Mts. 208 (1917), non King.

NETHERLANDS NEW GUINEA: Manokoeari, 60–150 m. alt., common in high forests, January 1914, *Gibbs 6172.*

PAPUA: Central Division, Koitaki, 450 m. alt., wood by stream, tree 6 m., receptacles on cauline branches, green with whitish spots and brown warts, April 1935, *Carr 11954;* near Rouna Falls, 270 m. alt., forest on steep rocky hillside, tree 6 m., receptacles on long branches, green, tipped darker and spotted brown, May 1935, *Carr 12365;* Boridi, 1050 m. alt., forest, tree 7.5 m., receptacles on lateral branches, green, spotted brown, October 1935, *Carr 14654;* North-Eastern Division, Kokoda, 360 m. alt., near stream in forest, slender tree 4.5 m. high, fruit in loose bunches from the trunk on long twigs of unequal length, May 1933, *Cheesman 30.*

Sect. NEOMORPHE

Ficus nodosa Teysm. & Binn. in Nat. Tijdsk. Nederl. Ind. **29:** 245 (1866).

PAPUA: Western Division, Lower Fly River, east bank opposite Sturt Island, rain forest, cauliflorous tree on river bank, stem plank-

buttressed, bark thin, reddish brown, fruit in paniculate clusters, about 3.5 cm. diam., smooth, reddish-brown spotted with green, October 1936, *Brass 8047;* Central Division, Veiya, sea-level, forest, tree 21 m., receptacles on short cauline branches, dull red spotted pale brown, March 1935, *Carr 11693.*

TERRITORY OF NEW GUINEA: New Britain, Möwehafen, tropical forest, fruit in small bunches from trunk, July 1937, *Blackwood 342* — Vern. Name, "taganum."

Ficus variegata Bl. Bijdr. 459 (1825).

PAPUA: Western Division, Lower Fly River, east bank opposite Sturt Island, rain forest of moister ridges, large canopy tree, stem spur-buttressed, bark grey-brown, fruit clustered on larger branches, few on stem, about 3 cm. diam., smooth, green flecked with white, October 1936, *Brass 8223;* Central Division, Veiya, sea level, forest, tree 24 m., receptacles on short cauline branches, green, March 1935, *Carr 11721.*

TERRITORY OF NEW GUINEA: New Britain, Möwehafen, sea level, tropical forest, tree, July 1937, *Blackwood 340* — Vern. Name, "malaya."

Sect. EUSYCE

Ficus distichoidea Diels in Engl. Bot. Jahrb. **67**: 221 (1935).

PAPUA: Central Division, Koitaki, 450 m. alt., in forest on an *Artocarpus,* climber, receptacles axillary, orange, May 1935, *Carr 12112.*

Ficus calodictya Summerh. in Jour. Arnold Arb. **10**: 149 (1929).

PAPUA: Central Division, Brown River, at Emia creek, 90 m. alt., climber, receptacles axillary, green, August 1935, *Carr 12925.*

Ficus Pantoniana King in Jour. Asiat. Soc. Bengal, **55**[2]: 407 (1887).

PAPUA: Central Division, Koitaki, 450 m. alt., climber on an *Artocarpus* in forest, receptacles axillary, orange-red turning purple when ripe, May 1935, *Carr 12113.*

Ficus cinnabarina S. Moore in Jour. Bot. **61**: suppl. 50 (1923).

PAPUA: Western Division, Palmer River, 2 miles below junction of Black River, 100 m. alt., very large root climber of forest canopy, fruit solitary or in pairs, axillary or in lateral fascicles of 2–4, depressed-globose, 3 cm. long, 3.5 cm. diam., red when ripe, soft, fleshy, covered with irritant hairs, July 1936, *Brass 7214;* Lake Daviumbu, Middle Fly River, stiff climber of rain forest canopy, fruit covered with brown irritant hairs, August 1936, *Brass 7463;* Lower Fly River, east bank opposite Sturt Island, common on ridges in rain forest, large root-climber, fruit about 3 cm. diam., green, covered with irritant brown

hairs, florets purple, October 1936, *Brass 8098;* Central Division, Koitaki, 450 m. alt., forest, climber, receptacles axillary, deep rose-red, June 1935, *Carr 12523.*

Ficus Baeuerleni King in Jour. Asiat. Soc. Bengal **55**[2]: 408 (1887).

PAPUA: Central Division, Koitaki, 450 m., stream bank in open country, climber, receptacles axillary, green, April 1935, *Carr 11960;* same locality and altitude, wood by stream, climber, receptacles axillary, rose-red, June 1935, *Carr 12591.*

Ficus fuscata Summerhayes, sp. nov.; a *F. obtusa* Hassk. foliis majoribus acutioribus basi leviter rotundatis tantum supra haud scaberulis costa et nervis subtus villosulis nec velutino-pubescentibus, receptaculis longius pedunculatis intus inter flores fere glabris distinguitur.

Scandens; ramuli siccitate longitudinaliter rugulosi, juventute dense fulvo-villosi, demum glabri, cortice pallide cinereo-brunneo obtecti, cicatricibus fere orbicularibus prominentibus foliorum delapsorum notati. Folia alterna, petiolata; lamina ovata vel elliptico-ovata, apice breviter acuminata, basi leviter rotundata, 9–17 cm. longa, 4–12 cm. lata, firme chartacea vel fere subcoriacea, basi trinervis, costa (ut nervi) supra impressa subtus prominente, nervis lateralibus utrinsecus 6–8 e costa angulo 30°–45° exortis prope marginem arcuatis inter se indistincte conjunctis prominentibus, nervis secundariis venis venulisque reticulationem crebrem distinctam efformantibus, supra laevis, in statu vivo nitens, praeter costam et nervos inferne villosulos glabra, subtus costa et nervis villosulis exceptis pubescens; petiolus 1.5–3.5 cm. longus, dorsaliter leviter compressus, fulvo-villosulus deinde glabrescens, laevis, brunneus; stipulae dense fulvo-villosulae, 6–8 mm. longae. Receptacula axillaria, gemina, pedunculata, feminea tantum visa, leviter depresse globosa, circiter 2 cm. longa et diametro, immatura pallide rubra, matura atro-purpurea, extra fulvide pubescentia, demum glabrescentia, intus inter flores fere glabra, bracteis basalibus basi receptaculi sitis annulatim conjunctis, ostiolo prominente fulvide villosulo-pubescente bracteis ciliatis; pedunculus circiter 6 mm. longus, setuloso-pubescens et sparse villosulus. Flores feminei saepissime sessiles; perianthii segmenta 3, anguste lanceolata, inter se adhaerentia, usque ad 4.5 mm. longa, ovarium includentia, glabra, rubro-brunnea; ovarium compresse oblongo-ellipsoideum vel sursum sensim angustatum, breviter stipitatum, 2.5 mm. longum, stylo subapicali gracili hyalino, stigmate brunnescente ± clavato cum aliis connato discum ± orbicularem efformantibus. Achaenia immatura late alata, laevia, brunneo-aurantiaca.

PAPUA: Central Division, Dieni, Ononge Road, 500 m. alt., climber in rain forest, upper side of leaves shining, receptacles depressed-globose, 2.2 cm. long, 1.8 cm. diam., pink becoming dark purple when ripe, May 1933, *Brass 3929*.

Not very closely allied to any New Guinea species known to me, but resembling *F. obtusa* Hassk. in general features and particularly in the receptacles and floral structure. *Ficus obtusa*, however, has the interior of the receptacle densely setose between the flowers whereas in *F. fuscata* it is almost glabrous. Both species are known only from the female receptacles. The perianth in both cases is more that of sect. *Sycidium* than of sect. *Eusyce*, but until the male plants are known no decision can profitably be made on this point.

Ficus trichosphaeridia Diels in Engl. Bot. Jahrb. 67: 225 (1935).

PAPUA: Central Division, Koitaki, 450 m. alt., forest, climber, receptacles axillary, brownish-olive with small red warts, June 1935, *Carr 12622*.

Ficus irritans Summerhayes, sp. nov.; affinis *F. trichosphaeridiae* Schltr., a qua habitu erecto nec scandente, foliis duplo minoribus basi leviter rotundatis nec cordatis subtus sparsiuscule adpresse pilosis, receptaculis brevissime pedunculatis paulo majoribus differt.

Arbor parva; rami novelli densiuscule adpresse pilosi, demum glabrescentes cortice rubro-brunneo longitudinaliter striato obtecti. Folia petiolata; lamina anguste lanceolato-elliptica vel elliptico-lanceolata, apice breviter acuminata, basi fere vel leviter rotundata, 5–11 cm. longa, 2.5–4 cm. lata, costa et nervis supra impressis subtus prominentibus, nervis lateralibus utrinsecus 4–6 e costa 30°–45° exortis curvatim adscendentibus prope marginem indistincte conjunctis, venis secundariis tertiariis et ultimis distinctis, supra juventute sparsissime adpresse pilosa demum glabra, subtus praesertim costa et nervis adpresse molliter pilosa; petiolus 8–12 mm. longus, teres, supra anguste canaliculatus, subdense adpresse pilosus; stipulae gemmarum lanceolatae, acuminatae, fulvide adpresse pilosae, 1–1.5 cm. longae. Receptacula axillaria, solitaria, brevissime pedunculata, depresso-globosa, matura fusco-rubra, 1.6–1.8 cm. diametro, extra pilis fulvidis irritantibus dense induta, intus inter flores sparse pubescentia, ostiolo leviter producto bracteis vix distinctis; pedunculus 2–3 mm. longus, ebracteatus. Flores masculi et feminei cecidiophori non visi. Flores feminei sessiles vel usque ad 2 mm. pedicellati; perianthii segmenta 3–4, oblanceolata, obtusa, basi angustissima, usque ad 2.5 mm. longa, glabra, rubro-brunnea; pedicellus sparsissime pubescens; ovarium breviter stipitatum, anguste oblongo-

ellipsoideum, circiter 2 mm. longum, stylo subapicali, stigmate irregulariter clavato cum iis florum aliorum cohaerente.

PAPUA: Central Division, Mafulu, 1250 m. alt., in forest regrowth, small tree, leaves shining above, receptacles soft, dark red when ripe, 1.6–1.8 cm., covered with irritant hairs, September–November 1933, *Brass 5260*.

This species, which appears from vegetative and floral characters to be a typical member of sect. *Eusyce,* is easily recognised by the small narrowly lanceolate-elliptical leaves with adpressed indumentum underneath and the almost sessile receptacles covered densely with irritant hairs, hence the specific epithet. Curiously enough, although an erect tree itself, its closest relatives are climbers, viz, *F. trichosphaeridia* Diels and *F. balanota* Diels. The differences between *F. irritans* and the former are given in the diagnosis; *F. balanota* has longer leaves with rounder base and soft spreading indumentum beneath, while its smaller receptacles have longer stalks, a much shorter indumentum and a remarkable cone-like projection at the apex leading up to the ostiole.

Ficus insculpta Summerhayes, sp. nov.; ex affinitate *F. sageretinae* Diels et *F. propinquae* Merr., ab illa ramis juventute magis pilosis, foliis latioribus siccitate bullato-rugosis, nervis subtus patentim vel fere recurvatim pubescentibus, receptaculis adpresse ferrugineo-pilosis apice latissime coronatis, ab hac foliis minoribus, stipulis vix persistentibus, receptaculis sessilibus praesertim apice adpresse ferrugineo-pilosis differt.

Scandens; caules teretes, juventute molliter et dense ferrugineo-subhirsuti, demum glabrescentes, cortice fusco-brunneo leviter longitudinaliter striolato lenticellis rotundatis minutis asperulo obtecti, radicibus caespitosis tenuibus glabris instructi. Folia ut videtur disticha, breviter petiolata; lamina lanceolato- usque orbiculari-ovata, apice leviter et breviter acuminata, basi aequaliter cordata vel rotundata, usque ad 8 cm. longa et 5 cm. lata, marginibus saepe leviter recurvatis, costa (ut nervis primariis et secundariis) supra impressa (folia supra subbullato-insculpta) subtus prominente, nervis primariis utrinsecus 5–8 e costa angulo 45°–50° exortis adscendentibus juxta marginem arcuatim conjunctis, reticulationibus ultimis subdistinctis, supra glabra vel basi pilis perpaucis instructa, nitens, subtus praesertim costa et nervis molliter patentim pilosa; petiolus crassiusculus, 5–15 mm. longus, teres, supra angustissime canaliculatus, subdense subhirsutus; stipulae dense hirsutae, circiter 1 cm. longae. Receptacula axillaria, solitaria vel gemina, sessilia, ± globosa, 7–10 mm. diametro, extra praesertim superne sparse

adpresseque ferrugineo-hirsuta, bracteis basalibus deltoideis paleaceo-membranaceis adpresse hirsutis deciduis, ostiolo prominente bracteis vix distinctis vel subprominentibus, intus inter flores glabra vel sparsissime setosa. Flores masculi prope ostiolum siti, sessiles vel breviter pedicellati; perianthii segmenta 3–4, libera, oblonga vel spathulato-oblonga, obtusa, circiter 1.5 mm. longa, glabra, rubro-brunnea; stamina 2, filamentis brevibus, antheris 1–1.2 mm. longis. Flores feminei cecidiophori (immaturi) sessiles vel breviter pedicellati; perianthii segmenta iis florum masculorum similia sed breviora; ovarium breviter stipitatum, obovoideo-globosum, stylo subapicali, stigmate vix incrassato 2–3-denticulato. Flores feminei (immaturi) sessiles vel breviter pedicellati, perianthii segmentis 3–4 ferrugineis oblongis usque lanceolatis, ovario vix evoluto stylo hyalino stigmate hyalino clavato.

PAPUA: Central Division, Mafulu, 1250 m. alt., climbing on tree trunks in forest, leaves stiff, glossy above, receptacles immature, September–October 1933, *Brass 5281* (subsidiary type—female plant); Boridi, 1440 m. alt., climber in forest, receptacles axillary, olive-green, September 1935, *Carr 14231* (TYPE—male-gall plant). A species easily recognised by the small very wrinkled and sub-bullate leaves spreading hairy beneath, and sessile receptacles with the ostiole placed at the apex of a broad obtuse but not well-marked crown.

Ficus hypophaea Schltr. ex Diels in Engl. Bot. Jahrb. **67**: 226 (1935).

PAPUA: Central Division, Alola, 1800 m. alt., climber in forest, receptacles axillary, red-purple, Jan. 1936, *Carr 14155;* Boridi, 1350 m. alt., climber in forest, leaves brown beneath, receptacles axillary, dark green, November 1935, *Carr 14497.*

Ficus Odoardi King in Ann. Bot. Gard. Calcutta **1**: 156, t. 198 (1888).

PAPUA: Central Division, near Rouna Falls, 270 m. alt., forest on steep rocky hillside, climber, receptacles axillary, brown, May 1935, *Carr 12359;* Koitaki, 450 m. alt., climber in forest, receptacles axillary or cauline, deep rose-red with golden hairs, June 1935, *Carr 12696;* Boridi, 1050 m. alt., climber in forest by a river, receptacles axillary, olive tinted red, October 1935, *Carr 14724.*

Ficus microdictya Diels in Engl. Bot. Jahrb. **67**: 229 (1935).

PAPUA: Central Division, East Mt. Tafa, 2300 m. alt., foothill forest on sheltered side of range, tree 15 m., leaves dark and shining above, pale beneath, receptacles axillary, solitary, depressed, 1.8 × 2.2 cm., green, May 1933, *Brass 4075;* Mt. Tafa, 2400 m. alt., rare in forests of narrow valleys, large tree, bark fibrous, pale brown, leaves smooth,

dark, midrib whitish, receptacles axillary, solitary, or in small lateral fascicles, 1.2 × 2.5 cm., September 1933, *Brass 4948;* same locality, 2550 m. alt., mossy forest on mountain side, 3 m. high, February 1934, *Cheesman 200.*

Ficus ihuensis Summerh. in Jour. Arnold Arb. **10:** 153 (1929); Diels, l.c. 187.

PAPUA: Central Division, Isuarava, 1440 m. alt., forest, tree 36 m., receptacles axillary, green suffused dull red, rose-red inside, February 1936, *Carr 15426.*

The Carr specimen cited above bears male-gall receptacles and these show that the species belongs to sect. *Eusyce* and not to sect. *Urostigma* as assumed by Diels.

Ficus incompta Diels, l.c. 229.

PAPUA: Central Division, Mafulu, 1250 m. alt., lower primary forest, tree 15 m. with numerous short lateral branches, leaves pale floccose beneath, September–November 1933, *Brass 5326.*

Ficus sp.

PAPUA: Central Division, Mafulu, 1250 m. alt., very common in forests and on roadside banks, scandent and closely adpressed to rocks or tree-trunks, galled receptacles up to 1.5 cm. diam., September–November 1933, *Brass 5348.*

This appears to be the early stage of some climbing species which probably develops very different leaves later on. The receptacles all seem to be abnormal, apparently having been attacked by some insect.

Sect. SYNOECIA

Ficus Scratchleyana King in Jour. Asiat. Soc. Bengal **55**[2]**:** 404 (1887).

PAPUA: Western Division, Palmer River, 2 miles below junction of Black River, 100 m. alt., rain forest of ridges, large root-climber adpressed to trunk and branches of large trees, fruit globose, soft, yellow, about 1 cm. diam., July 1936, *Brass 7173;* Central Division, Dieni, Ononge Road, 500 m. alt., large root-climber massed on trunk of rain forest tree, leaves dark, shiny, immature receptacles depressed-globose, 2 cm. long, 2.3 cm. diam., green with white flecks, April 1933, *Brass 3844.*

Ficus gymnorygma Summerhayes, sp. nov.; affinis *F. Carri* Corner, a qua foliis breviter petiolatis supra nervis vix impressis subtus fulvide subtomentosis foveis stomatiferis nudis, receptaculi ostioli bracteis prominentibus, florum femineorum perianthii segmentis linearifiliformibus hyalinis differt.

Frutex alte scandens; rami saepe simplices, juventute dense ferrugineo-tomentosi, demum glabrescentes, cortice brunneo obtecti. Folia (acrophylla) elliptico-lanceolata vel lanceolato-elliptica, apice breviter acuminata, basi ± rotundata vix vel haud obliqua, 8–16 cm. longa, 4–6.5 cm. lata, marginibus recurvatis, costa supra impressa subtus prominente, nervis primariis utrinsecus 7–9 infimis exceptis e costa angulo recto vel fere recto exortis juxta marginem arcuatim conjunctis subtus prominentibus, nervis secundariis minus distinctis, reticulatione indistincto, inter venas foveis stomatiferis latis sed haud profundis orbicularibus instructa, supra glabra, laevia, subtus praesertim nervis venisque ± dense fulvide subtomentosa, foveis stomatiferis glabris; petiolus subteres, 1.5–2.5 cm. longus, dense ferrugineo-tomentosus; stipulae breviter adpresse pubescentes, 12 mm. longae. Receptacula aurantiaco-flavida, axillaria, solitaria, breviter pedunculata, fere globosa vel ellipsoidea, 2.5–3 cm. longa, 2.3–2.7 cm. diametro, ostioli bracteis valde prominentibus acutis, extra breviter ferrugineo-pilosa, intus inter flores setoso-pilosa; pedunculus circiter 5 mm. longus, breviter ferrugineo-pilosus, basi vel supra basin bracteis tribus deltoideis acuminatis instructus. Flores masculi et feminei cecidiophori non visi; flores feminei verosimiliter sessiles, perianthii segmentis 3–4 lineari-filiformibus usque ad 4 mm. longis hyalinis, ovario ± longe stipitato ellipsoideo vel ± reniformi 2–3 mm. longo ferrugineo, stylo infra-apicali 1–1.5 mm. longo stigmate brevi bifido vel rarius trifido brachiis acutis hyalino. Flores neutri cum femineis commixti et eos aequantes, circiter 3 mm. pedicellati, perianthii segmentis 3 lanceolatis acutis 1.5 mm. longis hyalinis.

PAPUA: Central Division, Bella Vista, 1450 m., in oak forest, root climber with high climbing stems, leaves yellowish, receptacles orange-yellow, Nov. 1933, *Brass 5474*.

The climbing habit, stomata-bearing pits on the lower surface of the leaves and presence of neuter flowers in the seed receptacles indicate that the species should be placed in sect. *Synoecia*. It is, however, much to be regretted that male-gall receptacles were not collected. *Ficus gymnorygma* is the third representative of this section to be recorded from New Guinea, but instead of being allied to *F. Scratchleyana* King and *F. rhopalosycia* Diels, the other Papuan species, it much more closely resembles the Bornean *F. Carri* Corner. From this it differs in many features, the most striking one being that the circular pits on the lower surface of the leaf are glabrous instead of hairy, as in all other species of sect. *Synoecia* having these pits. Another aberrant character is the perianth of the female flowers which is (at all events, in the dried flowers) quite thin and hyaline instead of fleshy and coloured. There

is, however, a little doubt as to the nature of the structures which I have considered as the perianth. They are attached at the very base of the flower and may really be extra long receptacular hairs or perhaps the floral bract and the two bracteoles. If this interpretation is correct there is *no perianth* in the female flowers. The neuter flowers, although typical in general structure, have a thin hyaline perianth.

According to the collector's notes the species is a root-climber but unfortunately no portion bearing roots was collected. Nothing is stated about the presence of more than one type of leaf so that the occurrence of bathyphylls still remains doubtful; the description applies only to what are obviously acrophylls.

Royal Botanic Gardens,
Kew, Surrey.

NEW PHANEROGAMS FROM MEXICO, IV*

IVAN M. JOHNSTON

Atriplex Stewartii, sp. nov.

Frutex dioicus 2.5–5 dm. altus pallidus saepe erectus et globosus; caulibus numerosis ascendenter ramosis; foliis numerosis alternis oblongis vel late lanceolatis, majoribus 2–2.5 cm. longis 5–8 mm. latis infra medium vel rariter supra medium latioribus, basi cuneatis subsessilibus, margine integris vel sinuato-dentatis; floribus femineis in axillis foliorum minorum superiorum glomeratis; bracteis fructiferis corpus seminiferum quadrialatum rostro conspicuo terminali donatum formantibus; corpore (alis 1–4 mm. latis exclusis) subsessili 3–6 mm. longo 1.5–2.5 mm. crasso infra medium crassiore; rostro conspicuo 2–5 (–7) mm. longo lobos subaequilongos ligulatos vel cuneatos basim versus 1–1.5 (–2) mm. latos bifido supra alas corporis conspicue projecto; corpore alato a latere viso transverse elliptico vel suborbiculato usque ad ob-reniforme 5–10 mm. lato, basi saepe rotundato, apice rotundo vel truncato vel breviter lateque angulato-lobato, margine integro vel undulato rariter dentato-lobato; seminibus eas *A. acanthocarpae* simulantibus; floribus masculis spicas elongatas moniliformes formantibus numerosis; staminibus 5.

COAHUILA (Llano de Guaje): margin of playa at base of Lomas del Aparejo, abundant, erect globose bush 10–16 in. tall, August 28, 1940, *Johnston & Muller 777* (TYPE, Gray Herb.); margin of playa near Tanque La India, erect usually globose bush up to 18 in. tall, 1940, *Johnston & Muller 781* (G); margin of playa near Tanque La India, growing among low bushes and supported by them, stems 3 ft. long, 1940, *Johnston & Muller 785* (G).

This plant was observed only about the margin of the playa in the Llano de Guaje, about 100 km. northeast of Sierra Mojada. It grew with *A. obovata,* but was much more common than that species. The only other *Atriplex* observed in the region was *A. canescens,* which grew in the desert-scrub back from the dry-lake. The soil about the playa was only moderately saline. No species of *Suaeda,* for example, was found in the region.

The species is probably most closely related to *A. acanthocarpa* from which it is quickly distinguished by its fruit. The fruiting bracts bear

*New Phanerogams from Mexico, III. See Jour. Arnold Arb. **21**: 253–265 (1940).

4 well developed longitudinal wings, in the manner of *A. canescens,* rather than being covered with irregularly arranged numerous coarse flattened appendages. The fruiting bracts most suggest those of *A. linearis* and some forms of *A. canescens,* but differ in their very long slender conspicuous rostrum and in the lack of a stipe. The species commonly had a low bushy habit very similar to that of *A. obovata,* but some plants (represented by no. 785) had the sprawling habit of *A. acanthocarpa.* The leaves varied in form; some had leaves similar to those of *A. obovata* (no. 781), but most of the plants had sinuately toothed leaves suggestive of *A. acanthocarpa.* Of all the many plants examined only those in one colony had the bract with lobed wings. This is represented by no. 785. Some of the fruits of this collection have the wings well developed and subentire while others have some of the wings broken down into a row of flattened appendages. In habit of growth, foliage and fruit, therefore, this collection gives the clearest indication of the relationship of *A. Stewartii* and *A. acanthocarpa.*

I am naming this species in honor of my good friend Mr. Robert Stewart of Santa Elena Mines, who accompanied me when it was collected. Without Mr. Stewart's help, Mr. Muller and I could not have visited the great Llano de Guaje. In fact, he was responsible for much of the success of our collecting trip in Coahuila this past summer. Not content with contributing indirectly to the study of the Coahuilan flora, Mr. Stewart has now started to botanize. His name is very fittingly asociated with this interesting Coahuilan plant.

Atriplex reptans, sp. nov.

Planta dioica perennis rhizomatosa depressa prostrata pallida foliosissima; rhizomatibus valde elongatis ad 3–4 mm. crassis; ramis foliatis abundantibus, raro elongatis saepe congestis 2–5 cm. longis dense ascendenter ramosis; foliis oppositis crassulis ovato-oblongis vel elliptico-oblongis 2.5–4.5 mm. longis 1.5–2 mm. latis medium versus vel infra medium latioribus saepe quam internodiis subduplo longioribus basi connatis apice obtusiusculis; floribus masculis in axillis foliorum superiorum glomeratis; glomerulis 3–5-floris inconspicuis, lobis perianthii 4 triangulari-ovatis, filamentis ad 1.4 mm. longis compressis, antheris rosaceis; floribus femineis saepe solitariis in axillis foliorum superiorum gestis; bracteis fructiferis minutis inconspicuis 2.5–3 mm. longis infra medium et ultra connatis; partibus connatis 1.2–1.4 mm. latis (medium versus latioribus) 0.7–0.8 mm. crassis, faciebus alte convexis nullo modo appendiculatis vel rugosis, basi rotundis sessilibus; partibus liberis bracteae crassis stricte ascendentibus ovato-triangularibus, apice obtu-

siusculis, margine integris vel basim versus crasse unidentatis; seminibus brunneis crasse biconvexis radicula lateraliter erecta apice circa 4/5 altitudinis seminis attingente cotyledonem nullo modo superantibus; stylo fere ad basim bilobato.

COAHUILA: local on flats at the base of a gypseous ridge a mile or so east of Laguna de Jaco, September 9, 1940, *Johnston & Muller 1081,* pistillate (TYPE, Gray Herb.), *Johnston & Muller 1080,* staminate (G).

This remarkable *Atriplex* was discovered while travelling from San Vicente southwesterly to Jaco. It was seen only on the flats at the eastern base of the gypseous ridges to the east of Lake Jaco. These flats are probably flooded after each rain. The *Atriplex* is the dominant and most common and conspicuous plant upon them. It forms irregular mats frequently a meter or more broad. I suspect that the plant is gypsophilous. It is evidently related to *A. Watsoni* Nels. (*A. decumbens* Wats.) of the coast of California and Baja California. It agrees with that western plant in having opposite leaves and similar fruiting bracts. It differs conspicuously from this relative in having the staminate flowers in inconspicuous axillary glomerules rather than in conspicuous terminal moniliform spikes.

Fendlera rigida, sp. nov.

Frutex rigidus erectus 5–18 dm. altus supra intricate ramosus; caulibus saepe numerosis cortice nigrescente obtectis basim versus ad 1 cm. crassis, supra dense breviter ramulosis, ramulis subdivaricatis brunneis non raro subspinescentibus, internodiis ad 14 mm. longis; foliis saepe congestis, non raro subfasciculatis; lamina crassa lineari 10–15 mm. longa 1.2–2.5 mm. lata, apice rotundata vel obtusa, basi in petiolum 1–2 mm. longum 0.3–0.5 mm. crassum tomentulosum abrupte contracta, supra convexa vel medium versus supra costam obscure impressa basim versus villosula, alibi pilis pallidis rigidis 0.2–0.3 mm. longis adpressis sparsis ornata; marginibus folii valde revolutis costam latam planam subattingentibus et canaliculos duos angustos fundo pilis minutis abundantissimis barbellatis ornatos formantibus; floribus parvis apice ramulorum 1–3; pedicellis 2–4 mm. longis canescenti-puberulentibus; calyce canescente puberulente, lobis triangularibus ad 3 mm. longis acutis (maturitate ad 5 mm. longis saepe ascendentibus et media capsulam superantibus), tubo calycis ad 5 mm. diametro ad 2 mm. profundo; petalis albis extus medium versus sparse pilosis, lamina ovato-triangulari 4–5 mm. lata et 4.5–5.5 mm. longa apice acutiuscula margine saepe erosa, basi in unguem 3.5 mm. longum 1–1.5 mm. latum abruptissime contracta; staminibus sepalos superantibus, filamentis (i.e. a basi antheris usque ad basim

staminum) ca. 3.5 mm. longis, anthera (appendiculo apicale 0.6 mm. longo inclusa) 1.8 mm. longa quam lobis filamenti ca. 3 mm. longis breviori; stylo piloso ca. 3.6 mm. longo, ovario glabro; capsula late ovoidea (stylis persistentibus exceptis) ad 5 mm. longa.

COAHUILA: common on the coarse volcanic tuff near the mouth of the canyon at San Antonio de los Alamos, September 2–3, 1940, *Johnston & Muller 912* (TYPE, Gray Herb.).

A well marked species most closely related to *F. linearis* of the Sierra Madre near Monterey. It is a stiffer, more densely branched bush with shorter, more hairy leaves, broader sepals, and much shorter, stouter capsules. It was seen only in the Sierra San Antonio, in the vicinity of San Antonio de los Alamos, where it was confined to coarse volcanic tuff. It grew high on the canyon wall and on sunny flats, particularly favoring seams in the beds of tufa. In habit it formed a stiff upright bush with the short, stiff numerous branchlets intricately entangled above.

Genistidium, gen. nov. Leguminosarum.

Calyx campanulatus, lobis elongatis tubo longioribus, duobus superioribus alte connatis. Petala longe unguiculata, vexillo suborbiculato dorso infra apicem secus lineam medialem pilos minutos gerente alibi glabro, alis lunato-oblongis glabris late evidenterque auriculatis, petalis carinae obtuse lunatis evidenter lateque auriculatis margine tertia parte exteriore laminarum connatis. Stamen vexillare omnino liber basim versus puberulentum, stamina cetera in vaginam (margine basim versus puberulentam) connata. Antherae homomorphae. Ovarium subsessile 4–6-ovulatum. Stylus inflexus subteres subcorneus subulatus supra medium ubique barbatus apice stigmate capitato minuto terminali donatus. Legumen lineare compressum rectum bivalvatum uniloculare, valvis coriaceis, suturis crassiusculis. Semina suborbiculata compressa estrophiolata. — Frutex erectus parvus ramosissimus rigidus strigosus. Folia trifoliolata, foliolis integerrimis elongatis firmis enervatis exstipellatis. Stipulae rigidusculae subulatae minutae. Flores flavi in axillis foliorum superiorum saepe unifoliolatorum solitarii vel raro geminati.

Genistidium dumosum, sp. nov.

Planta fruticosa 2.5–5 dm. alta rigida globosa dense intricateque ramosa; ramis erectis numerosis abundanter ascendenter ramosis basim versus 2–3 mm. crassis inconspicue sed distincte 8–15-costatis, juventate pallidis dense strigosis deinde glabrescentibus et viridibus; foliis alternis abundantibus trifoliolatis dense strigosis, petiolis 1–4 mm. longis; foliolis oblanceolatis 5–18 mm. longis firmis medio-costatis sed enervatis apice

acutis, duobus lateralibus subsessilibus, foliolo mediali breviter petiolulato et majori; stipulis subulatis 1–1.5 mm. longis subpersistentibus; inflorescentia racemiformi dissitiflora bracteata; floribus in parte superiore ramulorum gestis ex axillis foliorum (saepe unifoliolatorum quam floribus saepe longiorum) orientibus, 5–25 mm. distantibus unoquoque breviter et inconspicue pedunculato; pedunculo ad 1 mm. longo summum ad apicem florem solitarium et bracteas duas subulatas 1.5–2 mm. longas strictas gerente; calyce basi plus minusve obliquo in pedicellum 2–3 mm. longum abrupte transmutato, tubo 2.5–3 mm. longo sparse strigoso, lobis duobus inferioribus fere ad apicem connatis cuneatis ad 3 mm. longis, lobis lateralibus et supremo subulatis 3 mm. longis; alis flavis, ungue curvato 4 mm. longo ad 0.8 mm. lato, lamina 6 mm. longa medium versus 2.5 mm. lata carinam 1–2 mm. superante; carina alba, unguibus 3.8 mm. longis, laminis 4.5 mm. longis et 2.8 mm. latis; vexillo flavo medium versus viridi-maculato, lamina ca. 8 mm. lata, ungue ca. 3 mm. longo; staminibus 5–6 mm. longis; ovario secus marginem superiorem strigoso; legumine (submature) strigoso recto 2–2.5 cm. longo ca. 4 mm. lato.

COAHUILA: frequent along the summit of the cliffs of volcanic tuff at San Antonio de los Alamos, September 2–3, 1940, *Johnston & Muller 944* (TYPE, Gray Herb.).

This small bush, though in gross habit much suggesting the *Papilionatae-Genisteae* of the Old World, is, doubtless, a member of the *Galegeae* and, particularly, of the *Galegeae-Craccanae* as defined by Rydberg, Am. Jour. Bot. **10:** 488 (1923) and No. Am. Fl. **24:** 156 (1923). It appears to have its closest relations in *Tephrosia* and *Peteria*, from which it differs in its dense bushy habit of growth, coarsely auriculate petals, trifoliolate leaves and bearded subulate (rather than flattened) style. From *Tephrosia*, in particular, it further differs in its veinless leaflets and completely free vexillar stamen. From *Peteria*, in particular, it further differs in the absence of spinescent stipules, and in the less well developed inflorescence, and better developed calyx-lobes.

The plant was seen only about the summit of the high cliffs of coarse volcanic tuff which dominate San Antonio de los Alamos. At this locality it was observed at several stations and was always scattered on level areas just back of the summit of the tuff-cliffs in arid exposed situations.

Nama Stewartii, sp. nov.

Herba succulenta foliosa erecta 1–2 dm. alta viscida e radice 2–4 mm. crassa palari annua oriens glandulifera (glandulis minutis stipitatis); caulibus solitariis vel pluribus saepe e basi sursum ramos elongatos

stricte ascendentes proferentibus hispidulis et glanduliferis; foliis succulentis alternis oblanceolatis apice angulatis obtusiusculis, supra medium latioribus deinde basim versus gradatim attenuatis, margine saepe revolutis, supra hispidulis subtus pilis sparsis obsitis vel subglabris; cymis numerosis apicem versus ramulorum gestis folia suffulcientia haud vel vix superantibus; pedicellis 1–4 (saepe ad 2) mm. longis; calyce sub anthesi 5–6 mm. longis, deinde 1–2 mm. longioribus, lobis erectis ciliolatis spathulato-linearibus apice ca. 0.5 mm. latis, fructiferis quam capsula subduplo longioribus; corolla infundibuliformi-campanulata 7–9 mm. longa rosacea, lobis 2.5–3 mm. latis rotundis; staminibus inaequalibus fere ad vel paullo supra medium cum corolla coalatis, parte libera 2–3.5 mm. longa subcompressa, parte adnata 2.5–3 mm. longa praesertim supra medium anguste alata; stylis distinctis hispidulis; capsula 3–4 mm. longa glandulifera compresse ovoideo-ellipsoidea; seminibus ca. 50 brunnea angulate subglobosis ca. 0.4 mm. longis minute alveolatis.

COAHUILA: Picachos Colorados, slope at west end of cliffs, 1940, *Johnston & Muller 139* (G); between Carrizo and Carricito on gypseous ridge, 1940, *Johnston & Muller 159* (G); Castillon, confined to gypsum flats, 1940, *Johnston & Muller 1271* (G); foothills of Sierra de las Cruces west of Santa Elena Mines, confined to gypsum-flats, 1940, *Johnston & Muller 228* (G); Sierra de las Cruces, gypsum flats and cliffs at south base of Picacho de San Jose, August 29, 1940, *Johnston & Muller 814* (TYPE, Gray Herb.)

This species is probably most closely related to *N. Havardii* of the Big Bend area in southern Brewster County, Texas, but is a lower, less robust, more branched and more juicy plant which is more glandular and has a much scantier indument. The herbarium specimens are green, rather than gray. The fresh plants are dense with numerous stems and thick fleshy leaves. They are light green and somewhat slimy. The corolla-lobes are an intense pink or rose color on the inner face and much paler on the outer surface. The corolla is smaller (7–9 rather than 9–12 mm.) than in *N. Havardii,* and the filaments are adnate only to about their middle, rather than distinctly above their middle as in *N. Havardii.* The species is gypsophilous and was found only on gypseous soils or on pure gypsum. In the eastern foothills of the Sierra de las Cruces, about Santa Elena Mines, it was present on nearly all the scattered exposures of gypsum, even on small isolated exposures of only a few square meters in extent.

It is a pleasure to associate the name of Mr. Robert M. Stewart with this interesting gypsophile. Mr. Stewart, drawing on his knowledge of the geological structure of the region, accompanied and guided me to

various exposures of gypsum in the area about Santa Elena Mines. It is appropriate that this, the most characteristic gypsophile of the Sierra de las Cruces, be associated with his name.

Petrogenia, gen. nov. Convolvulacearum.

Flores solitarii parvi in axillis foliorum superiorum brevissime pedicellati nullo modo aggregati pentameri. Sepala 5 inaequalia imbricata calycem et corollam superantia, bracteolis parvis. Corolla minima campanulata flava, lobis brevibus induplicatis sub anthesi ascendentibus. Stamina glabra, filamentis linearibus, antheris fundum sinuum loborum corollae vix superantibus. Ovarium perfecte biloculare 4-ovulatum. Stylus fere ad basim bifidus, stigmatibus duobus capitatis. Capsula globosa bilocularis saepe 4-seminata 2–4-valva membranacea apicem versus villosa. Semina glabra. — Herba prostrata fruticulosa sericea pilis dibrachiatis adpressis abundanter strigoso-vestita. Folia parva numerosa.

Petrogenia repens, sp. nov.

Planta perennis sericea; caulibus prostratis rigidulis laxe ramosis e radice palari profundo erumpentibus non rariter in nodis radiculas gerentibus foliosis elongatis 1–5 dm. longis saepe ca. 1 mm. crassis, internodiis saepe 5–10 mm. longis; foliis numerosis alternis, lamina firma elliptica vel lanceo-elliptica 3–9 mm. lata 7–14 mm. longa concolore apice acuta vel rotunda basi in petiolum 1–2 mm. longum gradatim vel abrupte contracta; floribus in axillis solitariis, pedicellis 0.5–0.8 mm. longis; lobis calycis inaequalibus; lobis exterioribus ad anthesim 3.5–4 mm. longis ovato-lanceolatis infra medium 1.5 mm. latis apice acutis, fructiferis ca. 6 mm. longis et 3 mm. latis ovatis acuminatis; lobis interioribus 2.5–3 mm. longis lanceolatis acuminatis basim versus ad 1 mm. latis, maturitate ad 5 mm. longis 1 mm. latis lanceolatis; bracteolis 2–2.5 mm. longis ca. 0.5 mm. latis, maturitate ad 3 mm. longis inconspicuis lobis calycis conspicue brevioribus; corolla viridi-lutea inconspicua quam calyce breviore 3–3.5 mm. longa, a basi ca. 1 mm. diametro sursum ad limbum 4 mm. diametro valde sed gradatim ampliata; lobis corollae 5 ascendentibus 1–1.2 mm. longis et latis apice late obtuso-rotundis extus infra medium sparse villosis alibi glabris, sinibus apertis angulatis; staminibus 5 ad 1 mm. supra basim corollae affixis, filamentis glabris linearibus 1 mm. longis basim sinuum corollae attingentibus, antheris in ambitu subcircularibus ca. 0.4 mm. diametro basim sinuum corollae vix superantibus; ovario 4-ovulato sub anthesi ca. 1 mm. longo subcylindraceo infra medium glabro apice stylos duos imam ad basim connatos ca. 1.9 mm. longos filiformes gerente; capsula bilocu-

lari (utroque loculo saepe biseminato) globosa ad 3.5 mm. diametro membranacea supra medium sparse villosa quam calyce breviore et ab eo laxe velata; seminibus saepe 4 glaberrimis ca. 2 mm. longis dorso convexis ventre angulatis.

COAHUILA: foothills of Sierra Hechiceros, 9 mi. south of El Tule, about rocks on gravelly ridge of rhyolite, 1940, *Johnston & Muller 1374* (G); Sierra de la Cruces near Santa Elena, limestone ledges, 1940, *Johnston & Muller 211* (G); Lomas del Aparejo, eastern margin of Llano de Guaje, limestone ledges, 1940, *Johnston & Muller 776* (G); south end of Sierra del Pino, limestone ledges, 1940, *Johnston & Muller 731* (TYPE, Gray Herb.); Sierra Planchada, 6 mi. northeast of Esmeralda, limestone ledges, 1940, *Johnston & Muller 835* (G); Sierra Almagre, limestone ledges, 1940, *Johnston & Muller 1162* (G); hillside 8 mi. west of Saltillo, about limestone rocks, 1938, *Johnston 7661* (G). CHIHUAHUA: Sierra San Carlos, road to mine, base of limestone cliffs, 1940, *Johnston & Muller 53* (G); Santa Eulalia Mts., limestone ledges, 1885, *Pringle 591* (G). SAN LUIS POTOSI: Minas de San Rafael, 1910, *Purpus 4915* (G).

This interesting little plant evidently belongs to the *Convolvulaceae-Dicranostyleae* as defined by Hallier, Bot. Jahrb. **16**: 569 (1893). The material collected by Pringle and Purpus has been determined as *Cressa,* but that is obviously incorrect, since the plant has a 4-seeded globose capsule, inconspicuous greenish campanulate corollas, a calyx of unequal lobes which invests both flowers and fruit, and stamens which are only barely exserted from the corolla. Finally, it is a rock-loving xerophyte, rather than, as in *Cressa,* an inhabitant of moist saline soils. By Hallier's key, p. 563, *Petrogenia* traces out either to the African genus *Seddera,* which differs in its small calyx, toothed filaments and very different style, or to the rather heteromorphic genus, *Bonamia.* Our present Mexican plant, however, differs from *Bonamia* in its small inconspicuous yellow corollas, the calyx which over-tops both corolla and fruit, the nearly exserted stamens, and its very different habit. I do not think that *Petrogenia* is closely related to *Bonamia.*

In western Coahuila *Petrogenia* is widely distributed and can be expected on almost any sunny hillside with ledges or cliffs of limestone. Its wiry creeping stems and silvery leaves commonly fill crevices on limestone ledges or form carpets about large rocks on slopes below limestone cliffs. Only at one locality, near the south base of the Sierra Hechiceros, have I seen this plant growing away from limestone rocks. At this locality it grew about large rocks on a sunny ridge formed of decomposed rhyolite. It seems probable that the igneous rock at this

locality was unusually basic since several other species, otherwise known only from limestones, grew with the *Petrogenia* there.

Salviastrum canescens (Gray), comb. nov.

Salvia texana var. *canescens* Gray, Proc. Am. Acad. **8**: 368 (1872).
Salviastrum texanum var. *canescens* (Gray) Cory, Rhodora **38**: 407 (1936).

Corolla pink, marked with two elongate yellow spots at the base of the lower lip, subtubular, 2 cm. long, villous-hispidulous outside, glabrous inside except for a few scattered hairs above the base; limb very oblique; tube 1.7–2 mm. thick at base, gradually expanding and becoming ca. 3.2 mm. thick at summit; lower (and most protruding) lip of corolla 5 mm. broad, 3.5 mm. long, broadly notched, abruptly narrowed at base into a claw 1.5 mm. broad and ca. 0.6 mm. long; lateral lobes rounded, 1.5–2 mm. long; upper lip about 1.5 mm. long, notched; stamens attached 15 mm. above base of corolla, rudimentary pair of stamens about 0.5 mm. long; fertile filaments compressed 1.5 mm. long, 0.25 mm. wide; larger anther-sac ca. 1.2 mm. long borne on a thick curved connective ca. 0.5 mm. long; smaller anther-sac about 0.9 mm. long, subsessile; style 15 mm. long, not exserted; stylar lobes 3–3.5 mm. long, flattened, lanceolate 0.5 mm. wide.

COAHUILA: dry chalky soil in a small open exposed arroyo near the high eastern ridge, Sierra del Pino northeast of Noria, 1940, *Johnston & Muller 646* (G).

The above cited collection agrees very closely with the original material of Gray's *Salvia texana* var. *canescens*. This variety has remained known only from fruiting plants collected near the Pecos River, Texas, by Charles Wright in 1849. A description of the corolla, from the new collection, is supplied above. This reveals that the variety, *canescens*, is not at all closely related to *S. texanum*. It is a plant with tubular corollas and evidently has its closest relations with *S. dolichanthum* Cory, from which it differs in its much smaller flowers, more slender fruticulose habit and different inflorescence. The flowers of *S. canescens* are lateral, being borne along the lower part of leafy shoots. The leaves surpass the subtended flowers. In *S. dolichanthum* the flowers are borne in a terminal inflorescence composed of numerous whorls of flowers and short bracts. The persisting stems of *S. canescens* are fruticulose and apparently represent several years growth. Those of *S. dolichanthum* are annual growth springing from a strong perennial root. The plant was seen only twice in Coahuila, once near the crest of the high eastern ridge of the Sierra del Pino and again at the mouth of the canyon at

the southern end of the same range. At both localities it grew in patches of chalky calcareous soil on dry sunny slopes. At both stations it was locally common.

Leucophyllum pruinosum, sp. nov.

Frutex 10–25 dm. altus, partibus junioribus griseis pruinosis molliter tomentosis pilis ad 0.5 mm. longis ramos graciles elongatos ca. 0.2 mm. longos superimpositos gerentibus; partibus vetustioribus plantae aliquantum glabrescentibus griseoribus; ramulis elongatis saepe 1–2 dm. longis ascendentibus; foliis alternis saepe 4–10 mm. distantibus, lamina ovata vel late elliptica vel suborbiculari costata sed enervata 8–16 mm. longa 5–12 mm. lata, apice rotundata vel obtusa, basi in petiolum 2–4 mm. longum saepe abrupte contracta, subtus saepe plus minusve pallidiore; calyce in alabastro candido (lobis late lanceolatis erectis) ad anthesi ca. 4 mm. longo 2–3 mm. longe pedicellato; corolla purpurea 9–14 mm. longa extus sparse glandulifera eam *L. ambigui* persimulante.

San Luis Potosi: rocky hillside 11 miles south of Matehuala, pale bush 12–24 dm. tall with purple flowers, 1938, *Johnston 7569* (type, Gray Herb.). Nuevo Leon: arid limestone slopes east of Soledad, 5500 ft., 1940, *Shreve & Tinkham 9695* (G); low shrub, loma near Doctor Arroyo, 6200 ft., 1940, *Shreve & Tinkham 9682a* (G).

This plant of southern Nuevo Leon and adjacent San Luis Potosi is a relative of *L. ambiguum,* of Hidalgo, from which it differs conspicuously in its indument. Typical *L. ambiguum* has a dense felt-like indument and is usually tawny. In *L. pruinosum* the herbage is covered with much less abundant coarser grayish or white trichomes and is loosely tomentose. The plant has a frosted appearance. Though related to *L. ambiguum,* the plant may be separated at a glance from its more southern relative.

Leucophyllum griseum, sp. nov.

Frutex 8–18 dm. altus rigide ascendenter ramosus, partibus juvenilibus pilos compositos minutos abundantissimos griseos gerentibus evidenter griseo-vestitis, maturis paullo glabrescentibus; ramulis 5–15 cm. longis numerosis ascendentibus, internodiis saepe 1–10 mm. longis; foliis alternis oblanceolatis vel rariter subobovatis 5–15 mm. longis saepe 2–5 (rariter ad 7) mm. latis costatis sed enervatis, apice rotundis vel obtusis, basi in petiolum 1–2 mm. longum gradatim contractis; calyce ad anthesim ca. 3 mm. longis basi in pedicellum saepe gracilem 1–2 mm. longum contractis, lobis lanceolatis ascendentibus; corolla purpurea 10–18 mm. longa, limbo 9–15 mm. diametro extus glabrato vel pilifero, lobis ovatis ascendentibus in facie interiore saepe piliferis.

COAHUILA: crest of an isolated hill one mile north of San Rafael (31 mi. south of Castillon), two plants, 9 dm. tall, 1940, *Johnston & Muller 198* (G); mouth of Cañon de Tinaja Blanca, Sierra de las Cruces, 1940, *Johnston & Muller 256* (G); foothills of the Sierra Planchada, 6 mi. north of Esmeralda, shrub 6–9 dm. tall, 1940, *Johnston & Muller 341* (TYPE, Gray Herb.); Parras, 1880, *Palmer 969* (G); Sierra de Parras, 1910, *Purpus 4639* (G); Sierra de Parras, 5500–6000 ft., 1940, *Shreve & Tinkham 9856* (G); rocky base of hills 3 mi. north of Peña Pass, bush 9–18 dm. tall, 1938, *Johnston 7721* (G). ZACATECAS: 21 miles south of Concepcion del Oro, 6–15 dm. tall, 1938, *Johnston 7353* (G); Cedros, *Lloyd 106* (G) and *? 58* (G).

This species is related to *L. minus* of western Texas, northern Chihuahua and extreme northwestern Coahuila, and probably includes most of the Mexican material which has been identified as that species. In floral structures, size and shape of leaves, and habit of growth, the plants are very similar. The two species differ, however, in the nature of their induments. In *L. minus* the indument is very dense and close and almost suggests a coating of aluminum paint. The very numerous small white trichomes are flat and stellate. The primary axis of the trichomes is extremely shortened and its tip appears as a small dot or knob at the center of the radially arranged arms. In *L. griseum* the indument is much less dense and more loose and at best appears as a dull thin grayish felt. The small grayish trichomes have a short but distinctly elongate axis along which the more or less unequal arms are borne at different heights. The tip of the axis projects well beyond the upper arms. The trichome is, hence, clearly three dimensional, rather than flat as in *L. minus*. During the past summer I visited the southern parts of the range of *L. minus* and the northern parts of the range of *L. griseum*. I found absolutely no evidence that these species intergraded. The species are readily distinguished in the field and herbarium.

Leucophyllum candidum, sp. nov.

Frutex globosus saepe 3–6 (rariter ad 12) dm. altus ramosissimus, ramulis saepe 5–15 cm. longis, internodiis saepe minus quam 1 cm. longis, partibus junioribus indumentum candidum densum tomentosum gerentibus; pilis abundantissimis elongatis verticellos plures superimpositos ramulorum longiusculorum gerentibus; foliis oppositis vel suboppositis numerosis concoloribus medio-costatis sed enervatis, lamina 6–10 (rariter ad 16) mm. longa 4–8 mm. lata late obovata vel raro oblanceo-obovata apice obtuse angulata basi in petiolum 1–3 mm. longum saepe abrupte contracta; calyce 3–4 mm. longo lobis 1–1.5 mm. latis acutis cum pilis elongatis ramosis abundantibus crasse vestitis; corolla

purpurea 12–17 mm. longa intus sparse pilifera, limbo 10–13 mm. diametro, lobis 4–5 mm. longis suborbiculatis tubo basi imo 2.5 mm. crasso; filamentis ca. 4 et 4.5 mm. longis sparse piliferis; ovario subglabro vel tomentoso; stylo glabro vel sparse pilifero.

COAHUILA: El Berrendo near Muzquiz, 4000 ft. alt., fl. purple, 1939, *White 1799* (G); limestone ledges near mouth of southern canyon, Sierra del Pino, pallid bush 1–2 ft. tall, not common, 1940, *Johnston & Muller 730* (G); crest of cliffs of volcanic tuff near San Antonio de los Alamos, frequent, globose bush 1–1.5 ft. tall, 1940, *Johnston & Muller 936* (G); between Carrizo and Carricito, on small ridge, local, bush 3–4 ft. tall, 1940, *Johnston & Muller 160* (TYPE, Gray Herb.); small isolated hill one mile north of San Rafael (31 mi. south of Castillon) abundant pallid shrub 1–2 ft. tall, 1940, *Johnston & Muller 199* (G).

This plant of northern Coahuila is closely related to *L. zygophyllum* of the dry valleys of southern Nuevo Leon. These two geographically well separated species differ in the size and form of the complex trichomes covering the herbage and accordingly in the nature and appearance of the indument. The trichomes of the northern *L. candidum* are relatively coarse, those on the leaves being about 0.2 mm. in diameter and those on the calyx being about 0.2 mm. long. The trichomes of *L. zygophyllum* are, at most, a quarter that size and are less rigid in texture. Even under 40–50 magnification the indument on the leaves of *L. zygophyllum* appears to be very dense and thin. The indument is so dense and thin that the older leaves, to the naked eye, appear to have a smooth grayish cuticle or a waxed surface rather than a coating of very abundant fine stellate trichomes. The thicker, whiter, felty indument of *L. candidum* is much less smooth and the coarser trichomes make it appear somewhat pulverulent or pruinose. The very much greater coarseness of the trichomes in *L. candidum* make its calyx-lobes and pedicels appear to be very coarse and thick.

The plant is a very attractive one and is probably widely distributed in the foothills of northern Coahuila. In addition to the stations where I collected it, I noted it in the foothills of the Sierra de las Cruces near Santa Elena Mines, at the base of the Sierra Almagre, and in the northern foothills of the Sierra Planchada north of Esmeralda. It was usually frequent locally and commonly growing with either *L. laevigatum* or *L. griseum*. Even when not in flower the plant is conspicuous for no other shrub in the region has an indument so white.

Haploesthes robusta, sp. nov.

Planta robusta succulenta glabra; caulibus 2–3 mm. crassis pluribus decumbentibus vel ascendentibus 15–20 cm. longis sparse ascendenter

ramosis foliosis e radice supra breviter crasseque ramosa erumpentibus; foliis glaberrimis 1–3 cm. distantibus 4–6 cm. longis, 1.5–2.5 mm. crassis linearibus basim versus compressis et 1.5–2.5 mm. longe vaginatis; capitulis 5–7 caules et ramulos terminantibus ca. 8 mm. altis, involucro cylindrico-turbinato ca. 6.6 mm. longo et 4.5 mm. crasso; tegulis viridibus ad 6 mm. longis 3.5 mm. latis ellipticis apice rotundis; floribus ligulatis ca. 5, tubo 4 mm. longo et 0.5 mm. crasso, lamina 3.5–4 mm. longa et 2.5 mm. lata apice minute bidentata; floribus disci 30–40 ca. 5 mm. longis, faucibus ca. 1.5 mm. longis ad 1 mm. crassis, lobis papillatis triangularibus ad 0.5 mm. longis erectis; achaeneis ad 2 mm. longis nigris ca. 15-costatis, costis angustis elevatis pilos ascendentes gerentibus.

COAHUILA: 3 miles south of Cuatro Cienegas, succulent plant on salt land, 2400 ft. alt., July 18–20, 1939, *Stephen S. White 1923* (TYPE, Gray Herb.).

In its habit of growth, coarse stems, very coarse large succulent leaves, and large heads, this species is readily distinguished from *H. Greggii,* the only other species described for the genus. It is a robust plant with coarse widely spreading pale annual stems springing from a very coarse perennial root. The florets are more numerous than in its relative, and with the exception of the blade of its ligules, they are larger than in its relative.

The type of *H. Greggii* was collected by Gregg at "Cienega Grande," Coahuila, a locality now called Cienega del Carmen. This is located in the hilly country 30 kilometers northeast of Parras, along the old road to Saltillo. *Haploesthes Greggii* is a plant of gypsum. The newly proposed species comes from saline soils at lower altitudes.

Perityle Castillonii, sp. nov.

Planta perennis ad faciem scopulorum adpressa 1–5 dm. diametro minus quam 1 dm. alta; caulibus pluribus fruticulosis e caudice lignoso saepe crasso erumpentibus; ramulis hornis foliosis 4–20 cm. longis gracilibus ad 1 mm. crassis sparse laxeque ramosis subcinereis minute villosulis, internodiis 3–30 mm. longis quam lamina foliorum longioribus; foliis oppositis; lamina deltoideo-ovata 5–25 mm. longa 4–25 mm. lata glandulis sessilibus aureis obsita sparse villosa, margine utrinque dentibus crassis 3–4 acutiusculis, basi truncata vel reniformi; petiolo quam lamina saepe breviore 3–15 mm. longo breviter villosulo; capitulis ramulos foliatos terminantibus discoideis 5–6.5 mm. altis 5–15 mm. longe pedunculatis; tegulis ca. 10 sub-biseriatis 3–5 mm. longis 0.4–1 mm. latis praesertim infra medium naviculatis unicarinatis apicem acutum

vel obtusum versus villoso-ciliatis alibi saepe sparse villosis; floribus 25–30 flavis; corolla 3–3.5 mm. longi, tubo ca. 1 mm. longo ad 0.5 mm. crasso glandulis stipitatis dense obsito, faucibus ca. 1.5 mm. longis ad 1 mm. crassis purpurascentibus sparse glanduliferis; lobis triangularibus ad 0.6 mm. longis; lobis styli ad 1.5 mm. longis subulatis supra medium barbellatis; filamentis ca. 0.9 mm. longis; antheris ca. 1.2 mm. longis appendiculas 0.3–0.5 mm. longas proferentibus; achaeniis ad 2.9 mm. longis nigrescentibus ca. 0.7 mm. latis, margine incrassatis haud vel vix ciliolatis, latere convexis minute et saepe adpresse hispidulis, apice haud coronatis epapposis vel rariter setam solitariam 0.5–2.5 mm. longam proferentibus.

COAHUILA: Canyon del Indio Felipe, Sierra Hechiceros, frequent in crevices of cliffs in deep canyon, Sept. 18, 1940, *Johnston & Muller 1359* (TYPE, Gray Herb.); Canyon del Indio Felipe, common in crevices of cliffs, Sept. 27, 1940, *R. M. Stewart 10* (G). CHIHUAHUA: dry sunny cliffs near "Virulento," 16 miles south of Trincheras, 1940, *Johnston & Muller 1430* (G).

The precise relationship of this species is uncertain. In Rydberg's treatment, No. Am. Fl. **34**: 11–27 (1914), of the *Perityle-Laphamia* complex, it might fall in either *Monothrix* or *Leptopharynx*, keying out to *Monothrix Palmeri,* of northwestern Arizona, or to *Leptopharynx Lemmoni,* of southern Arizona. Of these two species, the latter most suggests *P. Castillonii,* but differs in its broader tegules, larger corollas, and different indument.

The present species is one of the small depressed suffrutescent cliff-plants which Gray and Watson placed in *Laphamia*. The differences in habit of growth and in the breadth and keeling of tegules, which have been used to separate *Perityle* and *Laphamia,* so completely intergrade, that I am unable to find any real difference between the two genera. Rydberg attempted to sort the species of *Perityle* and *Laphamia* among six genera. Unfortunately, these segregate genera also intergrade and what is more serious seem to be flagrantly unnatural. I am forced to the conclusion that *Laphamia* and *Perityle* should be united and, accordingly, I am describing the present *"Laphamia"* as a species of *Perityle*.

The species appears to be restricted to the elevated igneous country of extreme northeastern Chihuahua and adjacent Coahuila. This highland is about 25 km. wide and nearly 100 km. long with a long axis roughly paralleling the Rio Grande which lies about 50 km. to the north. Its eastern end, the rhyolitic Sierra Hechiceros, extends into Coahuila north of Castillon. Its western end, the bedded lavas of the Sierra Coyote, extends to Trincheras, south of Ojinaga. The species was found at both

ends of this highland, at "Virulento," 26 km. south of Trincheras, where it was abundant, rooting in crevices of sunny basalt cliffs, and in and near the Canyon del Indio Felipe, in the Sierra Hechiceros, 35 km. north of Castillon. In the Sierra Hechiceros it was frequent on shaded cliffs in the Canyon del Indio Felipe, just within Coahuila and in the branch of that canyon leading to Rancho Encampanada, within Chihuahua. The plant is evidently a long-lived perennial. Rooted in crevices it forms a coarse dense woody caudex that may become a gnarled woody mass as big as a man's fist. The slender leafy branches are flattened against the face of the cliff. The material from the shaded cliffs of the Sierra Hechiceros have leaf-blades 10–25 mm. long, whereas those from the exposed cliffs at "Virulento," though of similar outline, are only 5–9 mm. long. The differences are evidently ecological.

This interesting plant is named in honor of Sr. Tirso Castillon, of Castillon, to whom I am indebted for a memorable trip, with him and Mr. Robert Stewart, into the Sierra Hechiceros. During this trip, near the northernmost point in the properties of the Hacienda de Castillon, at the head of the gorge of the Canyon del Indio Felipe, I obtained my first collections of the species.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

THE COMPARATIVE MORPHOLOGY OF THE ICACINACEAE
I. ANATOMY OF THE NODE AND INTERNODE

I. W. Bailey and R. A. Howard

With four plates

INTRODUCTION

Extensive investigations of a wide range of representative dicotyledons have demonstrated statistically that the structural specializations of the cambium and its derivatives tend in general to progress along a number of clearly defined lines. Not only are these salient phylogenetic modifications of the cambium and of the secondary xylem more or less closely correlated, but also at times they synchronize with morphological specializations of the foliar and floral organs. That they are significant in discussing the relationships and classification of families within certain orders of the dicotyledons has been shown by Vestal (9), Tippo (8) and Taylor (7).

Extensive exploratory investigations have now progressed to a stage where it becomes desirable to initiate *intensive* studies of specific families. This is essential in obtaining more detailed information regarding the relative rates of morphological specializations in different organs and tissues, in determining which trends of specialization are irreversible, and in securing clues regarding the actual significance of anatomical criteria in discussions concerning specific, generic and tribal relationships.

GENERAL PLAN OF PROCEDURE

In the case of most families of the dicotyledons, two types of material only are available at present for morphological and anatomical investigations, viz. (1) herbarium specimens and (2) the collections of woods assembled at Yale, Oxford and Harvard Universities and at other institutions. It is evident, accordingly, that in initiating an intensive study of a particular family, it is necessary to focus one's attention largely upon the secondary xylem and upon such tissues and organs as are adequately preserved in ordinary herbarium specimens, i.e. slender stems, leaves and flowers.

Our investigations of the Icacinaceae will deal successively with the gross anatomy of the node and internode, the histology of the tracheary

elements, parenchyma and rays of the cauline secondary xylem, and subsequently with the comparative morphology of the leaves, pollen and flowers. The Icacinaceae were selected for study because they exhibit a wide range of structural specializations and constitute a family that needs critical revision from the taxonomic point of view. Furthermore, the Icacinaceae were differentiated into sub-families and tribes by Engler (1) partly upon the basis of anatomical criteria. Therefore, there is a historical taxonomic precedent for dealing with this family from an anatomical aspect.

The bulk of the putative icacinaceous genera — approximately 60 — has been included in the Icacinoideae. Three genera only are referred to the sub-families Lophopyxidoideae and Cardiopterygoideae. In view of the fact that *Lophopyxis*, *Cardiopteryx* and *Ptelocarpa* are of questionable icacinaceous affinities, we shall defer consideration of these genera until later and confine our attention for the present to the Icacinoideae.

Our discussions of the vascular structures of this sub-family are based upon the study of 50 genera and of more than 150 species. As will be demonstrated subsequently, such a representation of genera and species is adequate for blocking out the salient lines of structural specializations in the Icacinoideae. Ten genera are not represented in American herbaria. Nor is it possible at present to obtain material of these rarer plants from European collections. Therefore, an analysis of the structure and relationships of these genera must be deferred until suitable material becomes available.

Tribes of the Icacinoideae

According to Engler (1 and 2), there are four tribes of the Icacinoideae which exhibit the following structural and anatomical differences:

1. Icacineae, trees or shrubs, seldom climbers. Vessels with scalariform perforations. Interxylary phloem absent.
2. Iodeae, climbing shrubs, sometimes with tendrils. Vessels with simple perforations. Xylem more prominently developed between the orthostiches of the stem.
3. Sarcostigmateae, climbing shrubs. Vessel elements short with simple perforations. Xylem uniformly developed around the stem. Interxylary phloem present.
4. Phytocreneae, climbing or twining shrubs. Vessel elements short with simple perforations. Xylem prominently developed between the orthostiches. Strands of mixed leptome and hadrome in the orthostiches, rarely continuous around the stem.

This classification of the Icacinoideae attempts to differentiate the anatomically more normal Icacineae from three distinct tribes of climbing plants which exhibit different anomalous modifications of the secondary body. In the case of the Phytocreneae, the so-called strands of mixed leptome and hadrome ("tracheids") actually are secondary phloem which projects into the secondary xylem of young stems of *Phytocrene, Pyrenacantha, Miquelia, Polycephalium* and *Chlamydocarya, Figs. 1 and 2.* These inwardly projecting strands of phloem in the orthostiches fluctuate in number depending upon variations in phyllotaxy, Robinson (3). Compare *Figs. 2 and 3.* They are composed of sieve tubes, companion cells, parenchyma and thick-walled, angular, more or less regularly oriented phloem fibers, *Fig. 4.* In young stems of *Trematosperma cordatum* Urb., as Engler (1) has shown, the strands are more numerous than the orthostiches and do not project conspicuously into the xylem. During subsequent growth of the young stems of *Chlamydocarya Soyauxii* Engl. and *C. Thomsoniana* Baill., they may be occluded in xylem. Such strands of interxylary phloem differ, however, from those of the Sarcostigmateae, *Fig. 10,* by being composed in part of thick-walled fibers, *Fig. 4.*

Although the young stems of the Iodeae, *Figs. 7–9,* may be differentiated from those of the Sarcostigmateae and Phytocreneae by the absence of interxylary phloem and of inwardly projecting strands of hard bast, there is some question whether they can be separated in all cases from those of the Icacineae upon the basis of the anatomical criteria listed by Engler. In the first place, as will be demonstrated in the next paper of this series, a number of the Icacineae are characterized by having vessels with simple porous perforations. In the second place, not all of the Iodeae have as large vessels or as prominently projecting wedges of secondary xylem between the orthostiches of young stems as the species investigated by Robinson (4), Engler (1) and others might lead one to suppose. In the third place, certain representatives of the Icacineae exhibit more or less conspicuous anomalous modifications of the secondary body.

As indicated in *Fig. 13,* the young stems of *Mappianthus iodoides* Hand.-Mazz. exhibit a normal cylindrical development of the secondary body. The vessels are of small size and are more or less uniformly distributed. This is in marked contrast to the conspicuously anomalous structure of such representatives of the Iodeae as *Iodes tomentella* Miq., *Iodes ovalis* Bl., *Fig. 7,* and *Iodes philippinensis* Merr., *Fig. 9.* The young internodes of *Hosiea sinense* (Oliv.) Hemsl. & Wils., *Figs. 5 and 6,* likewise have a normal cylindrical secondary body. In Wilson's material,

the vessels are of small size and are aggregated in three sectors of the secondary xylem, *Fig. 5;* whereas in Yü's specimens, *Fig. 6,* the vessels are relatively large and are more or less uniformly distributed throughout the secondary xylem. *A priori,* such conspicuous structural differences might be interpreted as due to errors in the determination of the specimens. It is significant in this connection, however, that similar structural variations occur in different lateral branches of the same stem of *Iodes liberica* Stapf. Certain of the branches have small vessels as shown in *Figs. 8 and 11;* whereas others have very large ones as illustrated in Fig. 12. Furthermore, the vessels may be uniformly distributed around the stem or may be aggregated in certain sectors of the cross section of the woody cylinder.

In the case of the Icacineae, scandent species of such genera as *Pleurisanthes, Leretia, Lavigeria,* etc., frequently exhibit a tendency to form relatively large vessels which may be aggregated in more or less prominently developed parts of the secondary xylem, i.e., between the orthostiches of young stems. That conspicuously anomalous structures are formed by successive cambia in the older stems of *Lavigeria salutaris* Pierre is indicated in *Fig. 16.* Such facts as these suggest that it may be difficult to differentiate the Iodeae from scandent representatives of the Icacineae upon the basis of Engler's anatomical characterizations of the two tribes.

NODAL ANATOMY

There are three distinct types of nodal anatomy in the stems of dicotyledons. In the *trilacunar* type of node, the vascular supply of the leaf produces three separate gaps in the stele, in the *unilacunar* type, a single gap, and in the *multilacunar* type, more than three gaps. Sinnott (5) has shown that these categories of nodal anatomy are significant in any comprehensive discussion of the relationships and classification of the various families of the dicotyledons. In addition, Sinnott and Bailey (6) have presented evidence which suggests that the primitive nodal condition in dicotyledons is trilacunar. Extensive unpublished investigations of the nodal anatomy of both seedlings and adult plants support this earlier inference, and indicate that the unilacunar condition arises from the trilacunar by the suppression of its lateral traces and corresponding gaps. The multilacunar condition develops from the trilacunar by the addition of successive pairs of lateral traces and gaps.

Although the finer details of the nodal structure of the Icacinaceae will be discussed later in connection with the leaf, it is advisable at this

point to emphasize the fact that the Icacinoideae may be divided into two distinct sections upon the basis of salient features of their nodal anatomy. One section of the sub-family is characterized by having trilacunar nodes, *Fig. 14*, and the other section by its unilacunar ones, *Figs. 1 and 15*. The multilacunar condition is not encountered in any of the Icacinoideae that we have studied.

TRILACUNAR — ICACINOIDEAE

ICACINEAE

Anisomallon	Dendrobangia	Lasianthera	Pittosporopsis
Apodytes	Discophora	Leptaulus	Platea
Calatola	Emmotum	Medusanthera	Poraqueiba
Cantleya	Gastrolepis	Oecopetalum	Stemonurus
Cassinopsis	Gonocaryum	Ottoschulzia	Urandra
Citronella	Grisollea	Pennantia	

UNILACUNAR — ICACINOIDEAE

ICACINEAE

Alsodeiopsis	Lavigeria	Merrilliodendron
Desmostachys	Leretia	Pleurisanthes
Humirianthera	Neoleretia	Rhaphiostylis
Icacina	Mappia	Rhyticaryum

IODEAE

Hosiea	Natsiatum	Mappianthus
Iodes	Polyporandra	

SARCOSTIGMATEAE

Sarcostigma

PHYTOCRENEAE

Chlamydocarya	Polycephalium
Miquelia	Pyrenacantha
Phytocrene	

It is evident from this tabulation of genera that there is one section of the Icacineae which resembles the Iodeae, Sarcostigmateae, and Phytocreneae in having unilacunar nodes. Furthermore, it is significant that a truly scandent habit of growth rarely, if ever, occurs among the trilacunar representatives of the Icacineae. On the contrary, several genera of the unilacunar Icacineae exhibit an evident tendency towards the acquisition of a scrambling, twining or climbing habit. This suggests that certain of the unilacunar Icacinaceae may be transitional in form and structure between the non-scandent, trilacunar Icacineae and

the unilacunar Iodeae, Sarcostigmateae and Phytocreneae in which a twining or climbing habit of growth is dominant. Such a supposition is strengthened by a study of the vessels of the Icacinoideae which will be discussed in the second paper of this series.

SUMMARY

1. The reasons for initiating an intensive study of the comparative morphology of the Icacinaceae are presented.

2. The general plan of procedure in this series of investigations is briefly outlined.

3. Engler's anatomical characterizations of four tribes of the Icacinoideae are discussed and the question is raised whether the Iodeae can be differentiated in all cases from the Icacineae by the suggested anatomical criteria.

4. A study of the nodal anatomy of the Icacinoideae reveals the fact that there are two distinct categories of the Icacineae, (1) those characterized by trilacunar nodes and (2) those having unilacunar ones.

5. Certain of the unilacunar Icacineae appear to be somewhat transitional in form and structure between the non-scandent, trilacunar Icacineae and the unilacunar Iodeae, Sarcostigmateae, and Phytocreneae in which a twining or climbing habit of growth is dominant.

LITERATURE CITED

1. Engler, A. Über die Verwerthung anatomische Merkmale bei der systematischen Gliederung der Icacinaceae. (Sitzber. K. Preuss. Akad. Wiss. **1893**: 247–269. 1893.)
2. ———— In Engler, A. and Prantl, K. (Die Natürlichen Pflanzenfamilien. III. **5**: 233–257. 1896.)
3. Robinson, B. L. Beiträge zur Kenntniss der Stammanatomie von *Phytocrene macrophylla*. (Bl. Inaug.-Diss. Strassburg. 1889.)
4. ———— On the stem-structure of *Iodes tomentella* Miq. and certain other Phytocreneae. (Ann. Jard. Bot. Buitenzorg, **8**: 95–121. 1890.)
5. Sinnott, E. W. Investigations on the phylogeny of the angiosperms. 1. The anatomy of the node as an aid in the classification of angiosperms. (Amer. Jour. Bot. **1**: 302–322. 1914.)
6. ———— & Bailey, I. W. Investigations on the phylogeny of the angiosperms. 5. Foliar evidence as to the ancestry and early climatic environment of the angiosperms. (Amer. Jour. Bot. **2**: 1–22. 1915.)
7. Taylor, F. H. Comparative anatomy of the secondary xylem in the Violaceae and Turneraceae. (Abstract) (Amer. Jour. Bot. **25**: 20. 1938.)
8. Tippo, O. Comparative anatomy of the Moraceae and their presumed allies. (Bot. Gaz. **100**: 1–99. 1938.)

9. Vestal, P. A. The significance of comparative anatomy in establishing the relationships of the Hypericaceae to the Guttiferae and their allies. (Philip. Jour. Sci. **64**: 199–256. 1937.)

DESCRIPTION OF PLATES

Plate I

Fig. 1. *Chlamydocarya capitata* Baill., *Linder 1076.*
Transverse section of the node. The vascular tissues of the leaf at (m) produce a single gap in the stele. × 14.

Fig. 2. *Chlamydocarya capitata* Baill., *Linder 1076.*
Transverse section of the internode, showing five wedges of large-vesselled secondary xylem and five strands of hard bast, correlated with a 2/5 phyllotaxy. × 11.

Fig. 3. *Pyrenacantha repanda* Merr., *Wenzel 2607.*
Transverse section of a stem having 1/3 phyllotaxy. The three arcs of large-vesselled xylem and the three strands of hard bast are separated from the internal primary body by a nearly normal cylinder of secondary xylem. × 22.

Fig. 4. *Chlamydocarya capitata* Baill., *Linder 1076.*
Transverse section of a strand of secondary phloem, showing sieve tubes and thick-walled fibers. × 90.

Fig. 5. *Hosiea sinense* (Oliv.) Hemsl. & Wils., *Wilson 960.*
Transverse section of a stem, showing four growth zones of small-vesselled secondary xylem. × 16.

Fig. 6. *Hosiea sinense* (Oliv.) Hemsl. & Wils., *Yü 1932.*
Transverse section of a stem, showing four growth zones of large-vesselled secondary xylem. × 16.

Plate II

Fig. 7. *Iodes ovalis* Bl., *H. U. 2775-J.**
Transverse section of the stem, showing "anomalous" development of large-vesselled secondary xylem. × 8.

Fig. 8. *Iodes liberica* Stapf., *Linder 1102.*
Transverse section of a stem, showing somewhat asymmetrically developed small-vesselled secondary xylem. × 25.

Fig. 9. *Iodes philippinensis* Merr., *Philip. Bur. Sci. No. 987.*
Transverse section of a stem, showing "anomalous" development of large-vesselled secondary xylem. × 25.

Plate III

Fig. 10. *Sarcostigma Horsfieldii* R. Br., *H. U. 2771-J.*
Transverse section of the xylem, showing included strands of soft bast. × 50.

Fig. 11. *Iodes liberica* Stapf., *Linder 1102.*
Transverse section of *Fig. 8* more highly magnified. × 50.

*The numbers *H. U. 2775-J* and *H. U. 2771-J* refer to specimens in the wood collection at Harvard University.

FIG. 12. *Iodes liberica* Stapf., *Linder 1102.*
Transverse section of another part of the same stem, showing large-vesselled secondary xylem. × 50.

PLATE IV

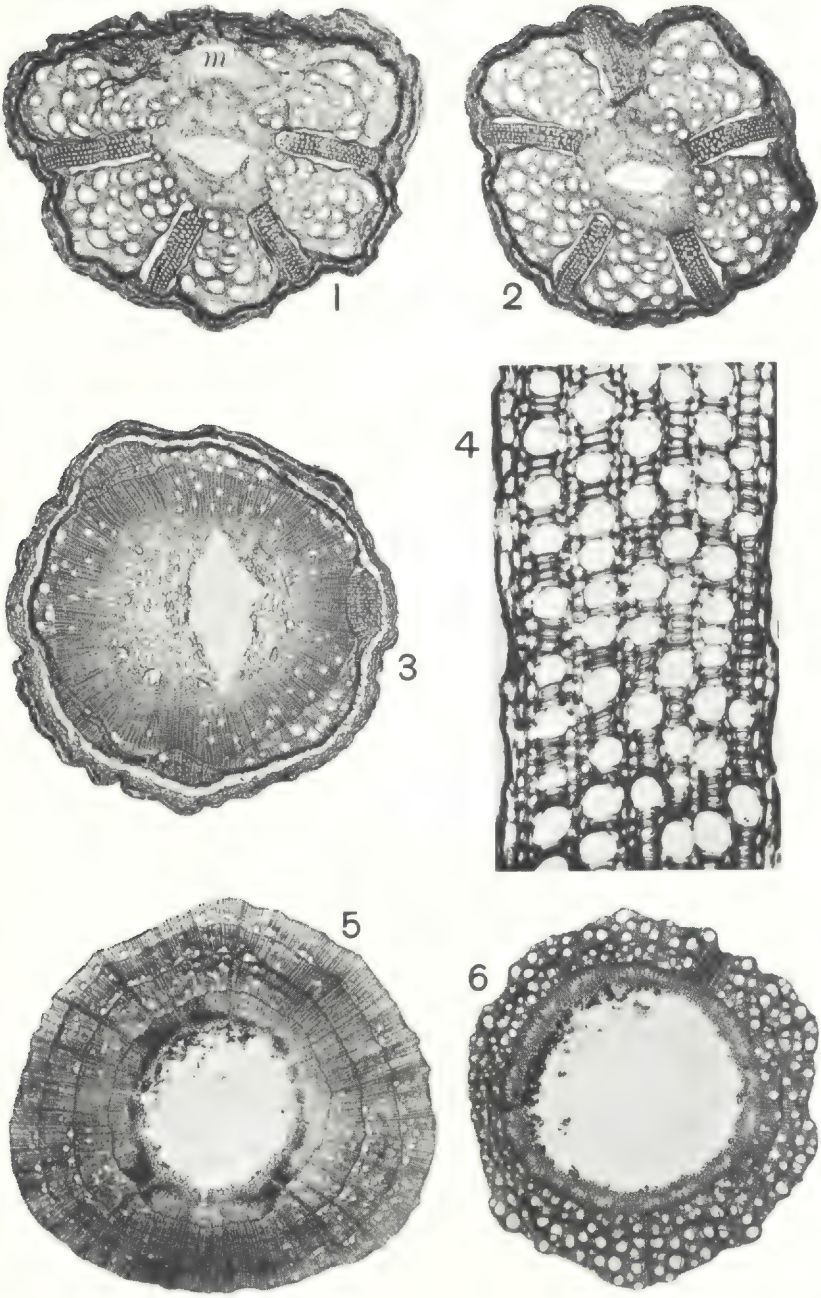
FIG. 13. *Mappianthus iodoides* Hand.-Mazz., *How 72874.*
Transverse section of a stem, showing normal development of the secondary xylem. × 20.

FIG. 14. *Citronella sarmentosum* (Baill.) Howard, *Bonati 1113.*
Transverse section of a node showing trilacunar condition. Median trace and gap at (m). Lateral traces and gaps at (l). × 22.

FIG. 15. *Lavigeria salutaris* Pierre, *Milbraed 10536.*
Transverse section of the node and the base of the petiole, showing unilacunar condition at (m). × 13.

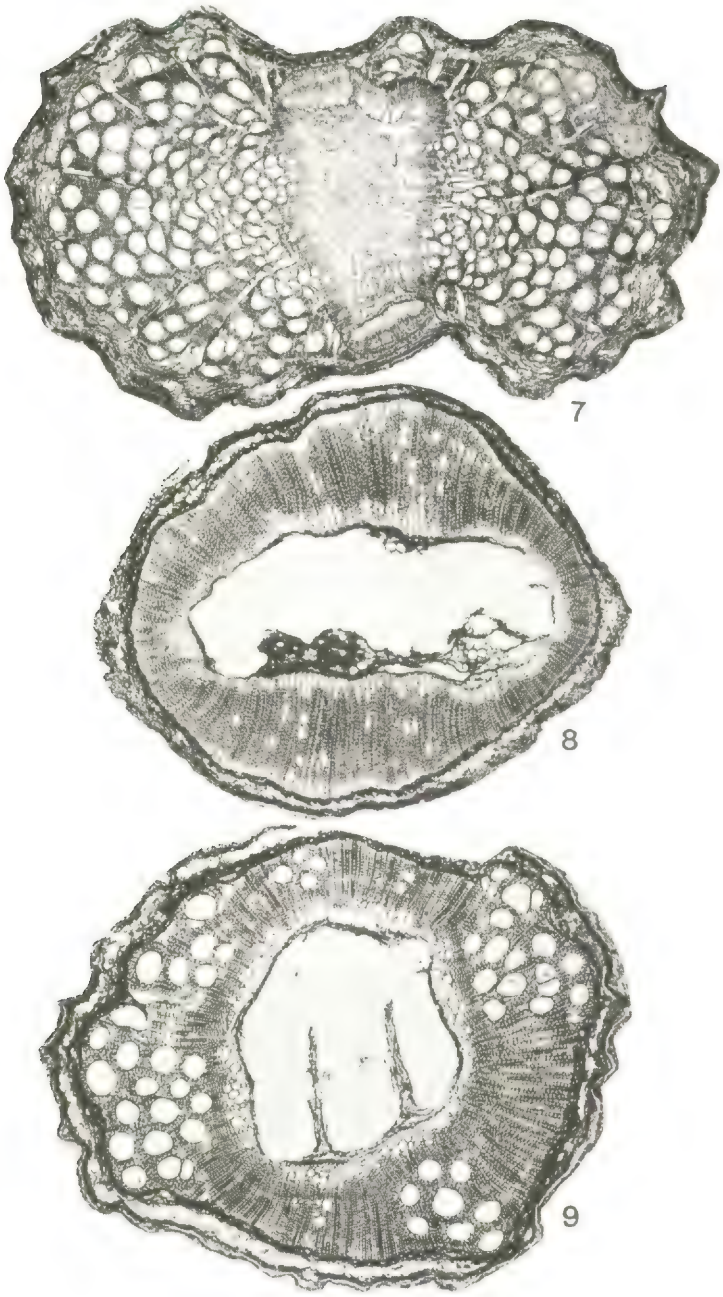
FIG. 16. *Lavigeria salutaris* Pierre, *Milbraed 10536.*
Transverse section of an older stem, showing "anomalous" structure formed by successive cambia. × 16.

BIOLOGICAL LABORATORIES,
HARVARD UNIVERSITY.



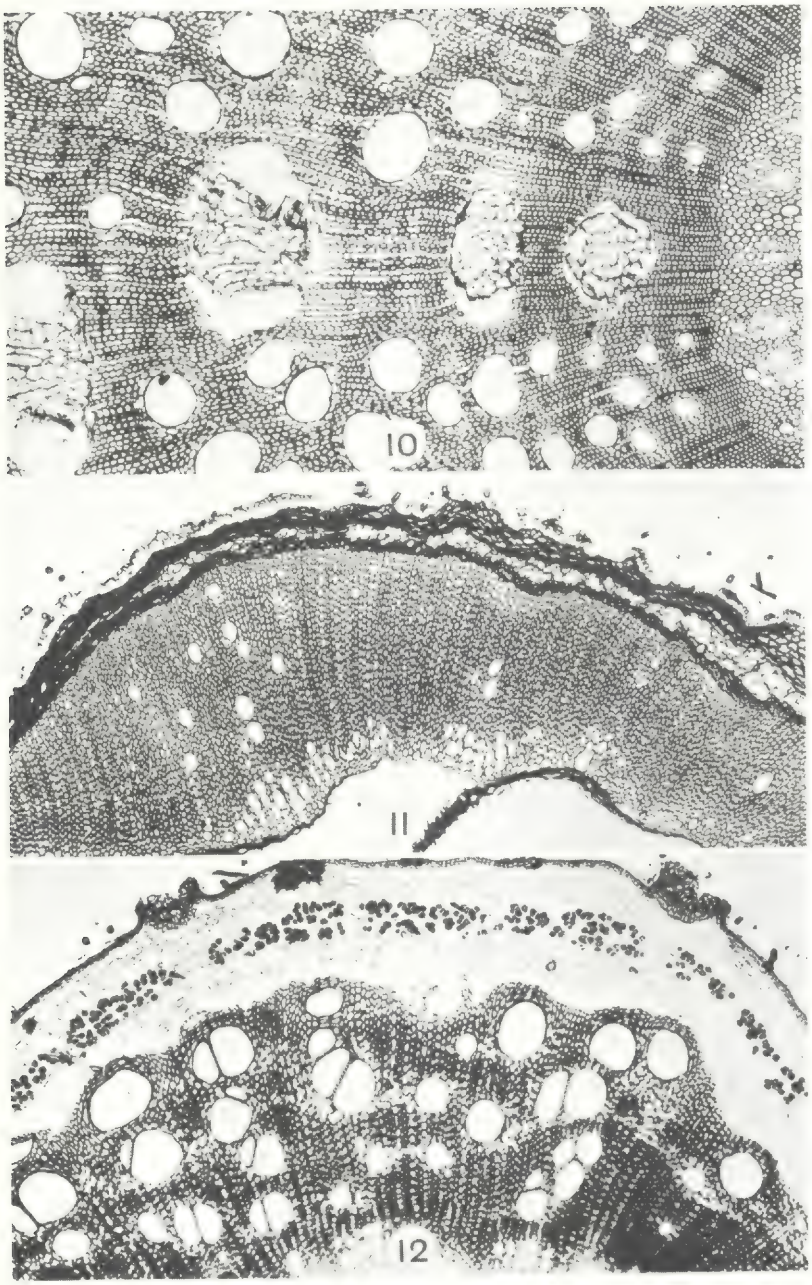
COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE — MERIDEN



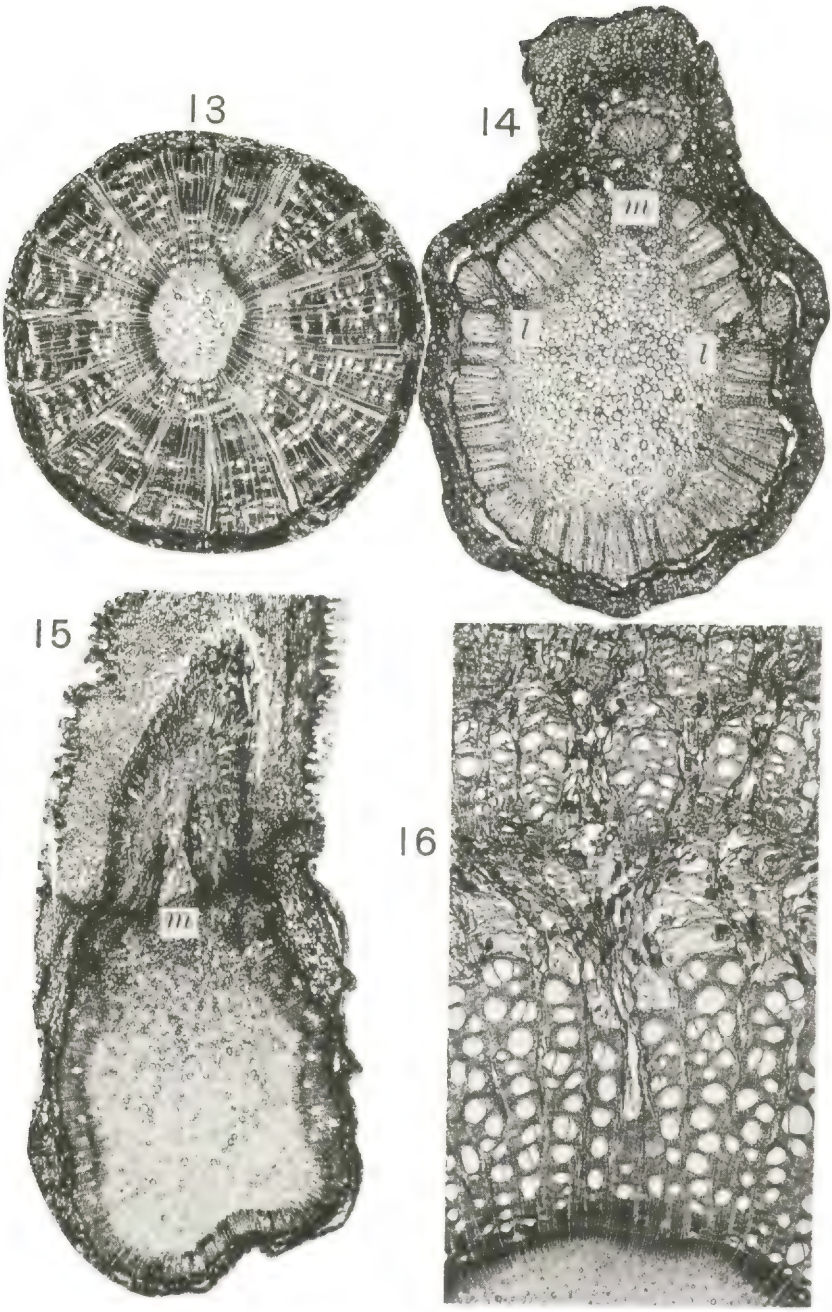
Comparative Morphology of the Icacinaceae

FULL-TONE — MERIDEN



COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE — MERIDEN



COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE — MERIDEN

A DISCUSSION OF NEW AND CRITICAL SYNONYMY

LEON CROIZAT

THIS PAPER is devoted to discussions of certain cases of synonymy having special taxonomic and nomenclatural interest. The treatment here outlined will be found useful in dealing with many more binomials and trinomials than it is possible to consider.

1. **Euphorbia Fendleri** T. & G., Pacif. Rail. Rept. **2**: 175. 1855.

Euphorbia Fendleri var. *dissimilis* Payson, Bot. Gaz. **60**: 379. 1915.
Euphorbia Fendleri var. *typica* Wheeler, Bull. Torrey Club **63**: 444. 1936 (*syn. nov.*).

Article 16 of the International Rules of Botanical Nomenclature, 1935, the cornerstone of priority, orders that a group with the same circumscription, position, and rank can bear only one valid name, this being the earliest legitimately published one. No exception whatever is made in this Article, or in any other Article, in favor of names holding the typic constituent of a group (here: var. *typica*). *Euphorbia Fendleri* var. *dissimilis* and *E. Fendleri* var. *typica* have the same position (both being published under *E. Fendleri*), the same rank (both being trinomials), the same circumscription (*Payson 119* and *Payson 493*, type-specimens of var. *dissimilis*, having the same taxonomic limits as *Fendler 800*, which is the type-specimen of *E. Fendleri* and *E. Fendleri* var. *typica*), the similarity of the circumscription being freely admitted by Wheeler himself (Amer. Midl. Natur. **21**: 527. 1939). It follows that Payson's name published in 1915 renders superfluous and illegitimate that of Wheeler, published in 1936 (see Art. 60 [1]).

Wheeler's fear that the biological complex under *E. Fendleri* is bound to bear the name *E. Fendleri* var. *dissimilis* under Art. 30 is mistaken. This Article does not apply, being concerned with a special case unrelated to the one here discussed; *Payson 119* and *Payson 493* have the same circumscription as *Fendler 800*, so that *E. Fendleri* var. *dissimilis* (1915) becomes the legitimate synonym of *E. Fendleri* (1855). Also misplaced is Wheeler's fear (*loc. cit.*) that: "the subdivisional name including the type of a species may shift, according to the vagaries of the individual, from a name based upon the type of the species to one based on another type." The subdivisional name including the type of a species is the nomenclatural type of the species, which, by definition of

Art. 18, is a constituent part of the binomial, and it may not be separated from it; its type-specimen is by definition the same as that of the binomial. Payson's variety does not include the "type" of *E. Fendleri,* as Wheeler claims, but is included under it, since this binomial is the earlier name, and its type-specimen (*Fendler 800*) and that of Payson's variety (*Payson 119, 493*) have the same circumscription.

It may be objected that, when published, *E. Fendleri* var. *dissimilis* was superfluous under Art. 60 (1), because there was a valid name (*E. Fendleri*) for the group to which this trinomial was applied. To this the answer is that under Art. 60 (1) a name is superfluous only if there was a prior valid name, with its particular circumscription, position, and rank. It is patent that *E. Fendleri* var. *dissimilis* was not superfluous, because this name is a trinomial, while *E. Fendleri* is a binomial, the ranks not being the same.

The reference here made to *Euphorbia* is not to be construed as the writer's acceptance of this generic name for the species involved.

2. **Sanicula canadensis** L. var. **typica** Wolff, Pflanzenr. 61 (**IV. 228**): 67. 1913.

Sanicula canadensis L. var. *genuina* Fernald, Rhodora **42**: 467. 1940 (*syn. nov.*).

In publishing *Sanicula canadensis* L. var. *genuina,* referred to the Linnean binomial "in part, as interpreted by Gray, Bicknell, and other authors," because he apparently objected to Wolff's description of var. *typica,* Fernald has violated five Articles and one Recommendation of the rules. He has violated Arts. 16 and 60 (1) in presenting a name (var. *genuina,* 1940) which has the same rank, position and circumscription of a name (var. *typica,* 1913) previously and legitimately published. He has violated Art. 59 in apparently rejecting as objectionable Wolff's name, merely because this name was accompanied by a description which did not agree with Fernald's own understanding of the Linnean plant. He has violated Arts. 47 and 50, believing that an alteration of diagnostic characters required a new name, whereas such alteration (Art. 47, emend. 1936) does not even require the indication of the name of the author correcting the diagnosis. He has acted against Rec. xxxii *quinquies* in failing to specify what part of the Linnean binomial he intended to include under his var. *genuina,* an omission which is significant in view of the previous existence of a legitimately published var. *typica* in the same circumscription, position and rank, this peculiarity requiring an "exact citation" in the fullest sense of the cited Recommendation. As it is well known (Rec. xviii and Rec.

xxxv) the epithets *typicus* and *genuinus* are perfectly synonymous, it being immaterial that Fernald published a var. *genuina* against Wolff's earlier var. *typica*.

3. **Sanicula canadensis** L. var. **grandis** Fernald, Rhodora **42**: 467. 1940.

Sanicula canadensis L. var. *typica* Wolff, Pflanzenr. 61 (**IV. 228**): 67. 1913, *quoad descr., excl. spec. Linn.*

Fernald cites under var. *grandis*, as a synonym, Wolff's var. *typica*. This is an incorrect citation, presented against Rec. xxxii *quinquies*. Wolff might have erred in improperly describing or interpreting the Linnean specimens when publishing *S. canadensis* var. *typica*, but the fact remains that this variety is based *by definition* upon the Linnean type-plant. Were it not so, the variety could not be designated as var. *typica*. Fernald admits, as a matter of course, that var. *typicus* has the same base as the binomial itself (cf. *Eupatorium album* L. var. *typicum* Fern. = *E. album* L. Mant. 111. 1767, cited in Rhodora **39**: 451. 1937), hence he may treat Wolff's var. *typica* as a synonym of his own var. *grandis* only to the extent of Wolff's alleged erroneous description, in no case including or involving in the synonymy the Linnean type-material.

4. **Lobelia Gaudichaudii** A. DC. in DC. Prodr. **7**: 384. 1839.

Lobelia Gaudichaudii var. *coccinea* Rock, Bull. Torrey Club **44**: 238. 1917; B. P. Bishop Mus. Mem. 7(2): 117. 1919.

Lobelia Gaudichaudii var. *typica* St. John & Hosaka, Occ. Pap. Bishop Mus. **14**: 118. 1938 (*syn. nov.*).

St. John and Hosaka are correct in claiming (op. cit., 120) that in a species having as many variations as *L. Gaudichaudii* it is desirable to assign a subdivisional name to the original binomial. They err, however, in claiming (op. cit., 119) that Rock's var. *coccinea* was superfluous under Art. 60 (1), because *Lobelia Gaudichaudii* is a binomial, while *L. Gaudichaudii* var. *coccinea* is a trinomial, the two names not having the same rank. They erred, furthermore, in publishing their own var. *typica*, 1938, when there already was in the record another name (var. *coccinea*, 1917) with the same circumscription, position, and rank, thus violating a precise disposition of Art. 16 and Art. 60 (1). The oversight made by Rock in publishing var. *coccinea* is not corrected by St. John and Hosaka's violation of the very same Article which they cite against Rock. It was open to them to publish legitimately the typical subspecies of *L. Gaudichaudii*, because a subspecies has not the same rank as a variety. The two authors' comment (op. cit., 120) that "Rock's varietal

name is not only illegitimate but undesirable, because if restated it would make Rock's instead of Gaudichaud's earlier collection the type" is mistaken. Rock's varietal name cannot be said to be illegitimate for the reasons previously given. This name, however, is to be treated as a synonym of *L. Gaudichaudii,* because it is based upon material (*Shaw 12742; Nelson & Stove 10003*) that has the same circumscription as *Gaudichaud 149* (1837). This last collection is the one that must remain as the type-specimen of *L. Gaudichaudii,* and to it must be ultimately referred for comparison all the type-specimens of subdivisions that may be published under this binomial.

5. **Solidago nemoralis** Ait. var. **longipetiolata** (Mack. & Bush) Palmer & Steyermark, Ann. Mo. Bot. Gard. **22:** 660. 1935.

Solidago nemoralis Ait. var. *decemflora* (DC.) Fernald, Rhodora **38:** 226. 1936 (*syn. nov.*).

The validity of combinations in which the full bibliographical reference of the basinym is not given has been questioned at length by Fernald (Rhodora **39:** 309–310. 1937), whose criticism induced Steyermark to re-present for alleged "validation" (Rhodora **40:** 131–134. 1938) a list of already validly published combinations. Like Fernald, Wheeler is of the opinion that a bibliographical reference is an essential part of the citation (Madroño **4:** 273. 1938), and he has affirmed (Amer. Midl. Natur. **21:** 528. 1939) that at present definite rules for judging the validity of new names and combinations are needed.

These and similar opinions ignore the very existence of Art. 46, which is already in the Rules, stating that: "For the indication of the name (unitary, binary, or ternary) of a group to be *accurate* and *complete,* and in order that the date may be readily verified, it is necessary *to cite the author who first published the name* in question" (italics mine). It may be added that Art. 28 even authorizes the reduction of more complicated combinations to ternary names, and accepts as a legitimate, or rather as an *accurate and complete citation,* such names as: *Saxifraga Aizoon* subforma *surculosa* instead of the full reference: *Saxifraga Aïzoon* var. *typica* subvar. *brevifolia* forma *multicaulis* subforma *surculosa.* Furthermore, Art. 48 states that whenever it is desirable or necessary to abbreviate a citation, the name of the publishing author being the most important must be retained. It is manifest, consequently, that the Rules do not require bibliographical data in order that a citation may be accurate and complete. In ignoring or rejecting *Solidago nemoralis* Ait. var. *longipetiolata* Palmer & Steyermark, and in presenting *S. nemoralis* var. *decemflora,* Fernald has vio-

lated Art. 58 and Art. 60 (1). Under Art. 58 it is immaterial that *S. longipetiolata* Mack & Bush, cited by Fernald as a synonym of his own combination, is later than *S. decemflora* DC., so long as it has been legitimately used in effecting a combination in a new rank.

6. **Cymbopogon Bequaerti** De Wild. Bull. Jard. Bot. Bruxell. **6:** 8. 1919.

Andropogon Bequaerti De Wild. loc. cit.; *nomen provisorium* sensu Art. 37 *ter*.

Sprague (Jour. Bot. **74:** 75. 1936) claims that provisional names (*nomina provisoria*) are illegitimate, while alternative or eventual names (*nomina eventualia seu alternativa*) are legitimate. This claim rests upon Art. 37 *ter*, which is the *only* Article in the Rules that is concerned with the matter, stating that: "A name of a taxonomic group is not validly published unless it is definitely accepted by the author who publishes it. A name proposed provisionally (*nomen provisorium*) in the anticipation of the eventual acceptance of the group, or of a particular circumscription, position or rank of a given group, or merely mentioned incidentally, is not validly published."

In publishing simultaneously *Cymbopogon Bequaerti* and *Andropogon Bequaerti*, De Wildeman proposed two names with the same circumscription and rank, one of them being necessarily a combination of the other in a different position. So doing, De Wildeman believed either that these two names were synonymous in the accepted taxonomic sense, or that they were not. If he did believe that the names were synonymous, he erred in publishing two names where one was sufficient, the other being superfluous (Art. 16, Art. 60 [1]) or illegitimate (Art. 40); if he did not so believe, he clearly acted to design a new combination "in anticipation of the eventual acceptance of the group," which is a patent violation of Art. 37 *ter*, and creates a *nomen provisorium*.

Contending, like Sprague, that alternative names are validly published, Furtado says (Gard. Bull. Straits Settl. **9:** 239–240. 1937) that the practice of publishing such names "has had an origin . . . which appears to me quite sound," and explains that if an author publishes a new species in a section or genus of disputable status, like, for instance, *Andropogon* and *Cymbopogon*, "a botanist in search of easy honours might at once seize the opportunity . . . to make new combinations under the alternative and disputed genus . . . It is to curtail such vexatious activity, and to keep the honour where it is due, that the practice of publishing simultaneous isonyms or alternative names has arisen. *Therefore it was but just that it was validated by the last Congress.*" (Italics mine.)

The "honour" of a botanist is a very minor consideration in the sight of the Rules (Art. 4), and Art. 37 *ter* specifically and peremptorily forbids as *nomina provisoria* names published in the anticipation of the eventual acceptance of the group. It is flagrant that Sprague's and Furtado's alternative and provisional names have the same status, Furtado stating that such names have been legitimatized by the Congress, 1935, precisely on account of the *very same* considerations that have induced the Congress to forbid the use of *nomina provisoria*.

It may be true that the discussion that preceded the actual voting of Art. 37 *ter*, as this Article now stands in the Rules, left some botanists under the impression that *provisional names* have been forbidden while *alternative names* have been permitted. However, the impression made upon some individual botanists is not to be confused as yet with the sovereign will of the Congress speaking its decision through an Article enacted in the Rules. The mere fact that *"seu eventuale"* was erased from the proposed draft of Art. 37 *ter* does not mean that eventual names have been approved by the Congress. Nothing can be "assumed" which is not clearly written in the Rules. The Rules themselves admit (Art. 5) that where the consequences of an Article are doubtful, established custom must be followed, such a "custom" being certainly not the private opinion of this or that expounder, nor, in the present case, that of multiplying the useless creation of names (Art. 4) to foresee future contingencies and combinations.

The editors of the Index Kewensis accept in practice the interpretation of *provisional* and *eventual* names as this is given here. They list *Cymbopogon Bequaerti* without comment, but follow the entry of *Andropogon Bequaerti* with the symbol "in syn.," which is tantamount to a rejection of its legitimacy with reference to Art. 40 of the Rules.

Some writers believe that names and combinations put forward without clear statement of rank, but with a suggestion that they belong in one or the other of two ranks, others besides the publishing author to make the conclusion, are *nomina provisoria* and not admissible under the "generally accepted Rules" (see, for instance, Fernald, Contr. Gray Herb. **131**: 266. 1940). This belief is hardly worthy of discussion. Names so published are legitimate because it is not an Article but a Recommendation (Rec. xxi), which is neither mandatory nor retroactive, that suggests that names should not be proposed without a statement of their rank. Any author may assign to these validly published names the rank which he believes to be fitting. These names, consequently, are absolutely not *nomina provisoria* in the sense of Art. 37 *ter*, because they are not proposed in the same publication and by the same author as

alternatives for other names, which is essential to the publication of a true *nomen provisorium*.

SUMMARY

With the exception of the last, the cases reviewed err in that they reveal an improper understanding of the type-concept, of the typical constituent of a binomial (trinomial *typicus, genuinus* and the like; cf. Rec. xviii and Rec. xxxv), and of priority. Such an improper understanding is displayed alike by editors and taxonomists, the cases here cited being a handful out of many, all of which are tainted by similar or identical errors.

It is undoubtedly very desirable that, as Art. 3 states, "the rules of nomenclature should be simple and founded on considerations sufficiently clear and forcible for every one to comprehend and be disposed to accept." Such simplicity and force, however, can be obtained only through a lucid and consistent interpretation of the Articles and Recommendations. The true needs of nomenclature are not determined by the needs of taxonomists who seldom use categories below the binomial. These needs are determined by the most involved and difficult cases that may arise under the Rules, because these are the cases that the Rules are most often called upon to solve.

It is a matter of common knowledge among taxonomists that one name and one type-specimen (for instance, a binomial and its type-specimen) may be used as the source of many combinations, all of which are "based" on the same name and type-specimen. Thus at the will of a taxonomist the same name and specimen may be treated as a variety, as a subspecies, as a species, and the like. The segregation of subsp. or var. *typicus* or its equivalent (cf. Rec. xviii, xxxv) is merely one of the many combinations that can be effected under the Rules around *the same name and the same type-specimen*. It is manifest that this combination, like every other one, cannot be effected in violation of priority (Art. 16, Art. 60 [1]). Thus it cannot be effected when there already exists in the record a group with the same circumscription, position, and rank. To effect it legitimately, Art. 16 would have to be amended, and a special clause inserted to the effect that the constituent element of a binomial or unit of lower rank (cf. Art. 18) is not subject to the action of the principle of priority. Such an amendment may be desirable or not, which is not the province of these brief notes to decide. What brooks no doubt is that so long as Art. 16 is not so amended, its provisions *must be respected*. To violate them means to publish an illegitimate name, which must be rejected. It may be

very desirable, as St. John and Hosaka point out (*loc. cit.*) to segregate a trinomial *typicus* in a group having many forms, but such segregation cannot be made, in this case, as Articles 16 and 60 (1) now read. Nothing can be assumed by anyone as being in the Rules (see Art. 74) which is not provided for by an Article previously approved by the Congress.

When taxonomists speak of a "type" they generally understand a *specimen* which is the base of a name. The Rules, on the contrary, understand as "types" both *specimens* and *names*. This distinction may be wise or not, which does not come here under discussion. The fact remains that such a distinction is made. To illustrate: Recommendation vii gives the utmost importance to the preservation of the original material on which the description of a new group is based, which this Recommendation calls "type," and which certainly agrees with the *type* that is commonly understood by taxonomists. Recommendation v, on its part, states that when revising a genus, an author should state which species he accepts as the nomenclatural type. Furthermore, Art. 18 legislates that a nomenclatural type is not necessarily the most typical or representative element of a group. It is manifest that the nomenclatural type spoken of by Rec. v and by Art. 18 is not a specimen nor its equivalent description or figure. In fact, the specimen or specimens that "typify" a genus are not designated by an author who *revises* the genus; they are designated by the author who *describes* the genus, barring insignificant exceptions (*species lectotypicae*). Moreover, it is not to be understood how Art. 18 can speak of the nomenclatural type not being "the most typical or representative element of a group," and Rec. vii can speak of the "type" on which the description of the new group is based, if these two "types" are the same thing. It is evident that these two types are not the same thing, that is to say that the nomenclatural type is a *name* (unitary name, binomial, trinomial, and the like) and the "type" in the sense of Rec. vii is a *specimen* or *figure* or *description*.

Having introduced so subtle a distinction in the concept of type, the Rules should have been amplified, thus effecting a proper discrimination in their Articles and Recommendations when speaking of "types." The astounding truth is that the Rules fail to do so. The best example of this confusion and contradiction is to be found in Art. 18, which, as it were, is the Article that clarifies the "type method" itself. This Article states that the nomenclatural type (sic) of a species is a specimen, description, or illustration, while Rec. vii and Art. 18 itself, as previously cited, imply that this type is a name. As the nomenclatural type of

Polyporus amboinensis, Art. 18 cites the figure and the description in Rumphius, Herb. Amboin. **4:** 129, *t. 57, 1.*

To clarify the issue, let us suppose that we segregate from *Polyporus amboinensis* the trinomial *typicus* and, having done so, we seek in the Rules an answer to the question whether the nomenclatural type of this binomial is the trinomial *typicus* or *plate 57, 1* of the *Herbarium Amboinense.* The answers we obtain are contradictory: Recommendation xviii and Rec. xxxv tell us very definitely that this type is the trinomial *typicus;* Rec. iv reveals that this type is either *plate 57* or the trinomial *typicus;* Art. 18 states that this type is only *plate 57,* but by implication contradicts itself, as previously seen, speaking of a nomenclatural type "which is not the most typical or representative element of the group."

So glaring and so inexcusable a contradiction spreads itself *all over the Rules,* in which the term "type" means arbitrarily names or/and specimens (cf. Recs. v, vii; Arts. 21[2], 30, 51, 52). In view of this contradiction and confusion it is not surprising that individual taxonomists should feel unequal to the task of coping with the term "type," and should be lost in a maze of contradictions and doubts when trying to attempt the solution of difficult problems of nomenclature. These problems involve a rigorous understanding of circumscriptions (defined by type-specimens, that is to say by *physical types*), of ranks (defined by names, in many cases these names being *nomenclatural types*), and of positions (involving transfers of names, with the specimens usually remaining unaffected). Thus, for instance, in the case of *Lobelia Gaudichaudii* previously discussed, *L. Gaudichaudii* var. *coccinea* has a very peculiar state in nomenclature and typification. It has the same rank and position as a potential *L. Gaudichaudii* var. *typica;* it has the same circumscription as this trinomial, because its type-specimens (*Shaw 12742; Nelson & Stove 10003*) have the same limits as *Gaudichaud 149* (1837), which is the physical type of both *L. Gaudichaudii* and *L. Gaudichaudii* var. *typica.* This notwithstanding, *L. Gaudichaudii* var. *coccinea* has not the full nomenclatural status of *L. Gaudichaudii* var. *typica* because it is not based upon the very same type-specimen of *L. Gaudichaudii.* However, not having the status of var. *typica, Lobelia Gaudichaudii* var. *coccinea* nevertheless forbids that var. *typica* be legitimately segregated, because it has the same position, circumscription, and rank as this trinomial (cf. Art. 16; Art. 60 [1]). Last but not least, var. *coccinea* is not superfluous in the sense of the Rules (Art. 60 [1]), because to be such it should have the same position, circumscription, and *rank* as *L. Gaudichaudii,* which is a binomial, not a trinomial. In brief, the

tangle of specimens and of names, of ranks and of circumscriptions is so close that we must marvel how St. John and Hosaka could ever hope to unravel it in the course of a brief taxonomic treatment. The reader is referred to Wheeler's writings (Contr. Gray Herb. **127**: 58. 1939; Amer. Midl. Nat. **21**: 527–529. 1939) for classic examples of meaningless discussion, in which the term "type" means things unknown and unknowable.

It is manifest that Art. 18 must be amended to read that the *nomenclatural type* of a species, or subdivision thereof, is the subdivision *typicus* or its equivalents (Rec. xviii, xxxv) next below in rank, specimens and descriptions being on the contrary *physical types* that determine the circumscription of the names. A careful study of Art. 4 and Art. 60 (1) is also advisable to see whether the "useless creation of names" may be made to cover the publication of such names as *Lobelia Gaudichaudii* var. *coccinea*.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

A NEW GENUS OF FLACOURTIACEAE (PANGIEAE — HYDNOCARPINAE) FROM TROPICAL QUEENSLAND

C. T. White

With one plate

Baileyoxylon gen. nov. Flores dioici. Calyx 5-lobatus. Petala 5 valde imbricata, squamis hirsutis magnis totidem oppositis. Flores masculi: Stamina 5, petalis alterna, antherae magnae, loculis rima laterali dehiscentibus, filamentis brevis applanatis in connectivo lato gradatim productis. Flores foemini ignoti. Fructus ignotus. Arbor. Folia penninervia. Paniculae axillares et laterales, thyrsoideae.

Species 1 in Australia boreali crescens.

The genus is dedicated to Dr. Irving W. Bailey.

Baileyoxylon lanceolatum sp. unica.

Arbor ad 25 m. alta, cortice griseo (Kajewski), ramulis robustis lenticellatis, novellis ferrugineo-pubescentibus mox glabris. Folia petiolata, lanceolata, apice acuminata, basi cuneata; nervi et venuli supra indistincti, subtus leviter elevati; nervi praecipui ca. 10 in utroque latere, in venam intramarginalem irregularem 5–6 mm. remotam conjuncti; petiolus subrobustus, 1–1.5 cm. longus; lamina 10–16 cm. longa, 4–5 cm. lata. Paniculae thyrsoideae multiflorae axillares et laterales, 4–10 cm. longae, ramulis ultimis dense ferrugineo-pubescentibus basim versus gradatim glabrescentibus. Pedicelli robusti 1–2 mm. longi. Calyx extus ferrugineis pilis sparsis vestitus, 2.5 mm. diam., 5-lobatus, lobis rotundis. Flos masc.: Petala 5, imbricata, ovata, 3 mm. longa, cremeo-viridia (Kajewski) intus squama (aurantica — Kajewski), hirsuta petalum fere aequantia aucta. Stamina 5, cum petala alternantia, filamentis perbrevibus in connectivum latum gradatim attenuatis, antheris 2 mm. longis. Flores foem. et fructus ignoti.

Ghurka Pocket (Atherton Tableland), alt. 700 m. (common in rain forest), *S. F. Kajewski 1230* (male flowers in advanced bud), Sept. 24, 1929 (small tree, up to 15 m. high, leaves dark green); Boonjie (Atherton Tableland), alt. 700 m. (common in rain forest), *S. F. Kajewski 1263* (type: flowering specimens), Oct. 3, 1929, (medium sized tree, up to 25 m. high, bark medium grey, light yellow when cut, wood light yellow, petals cream-green, each petal having inside it a smaller orange "petal").

As there was some difficulty in satisfactorily placing Kajewski's plant, specimens were handed over to Dr. I. W. Bailey for help in elucidating its botanical affinities by anatomical means. Dr. Bailey kindly undertook to do this, and reported: "The general anatomical structure of the stem (including the node) is typically flacourtiaceous. Furthermore, it is of the more primitive structural type such as occurs in the Oncobeae and Pangieae. The combined structural and floral evidence suggests that the tree probably belongs in or near the Hydnocarpeae. The plant differs from such genera as *Hydnocarpus, Taraktogenos,* and *Trichadenia,* yet exhibits a combination of structures that occur in these genera. For example, the form of the stamens and the structure of the pollen are similar to certain species of *Hydnocarpus* and *Taraktogenos,* but unlike those of *Ryparosa.* Unfortunately, I have not been able to obtain pollen of the genus *Trichadenia.* Analysis of the leaf reveals no evidence which would exclude the plant from the Hydnocarpeae. On the contrary, certain structures of the leaf are suggestive of relationship with this group. In other words, I suspect that the plant is a new genus related to the Hydnocarpeae."

Later, flowers of *Trichadenia* were obtained from the U. S. National Herbarium, and the pollen examined by Dr. Bailey, who reported: "I have received some flowers of *Trichadenia.* The pollen of *Hydnocarpus, Taraktogenos, Trichadenia,* and the Queensland tree belong to the same general structural type which differs markedly from that of *Ryparosa.* The pollen of *Trichadenia* and of the Queensland plant both have a coating of oil or fat which brings them into closer relationship. The evidence from pollen, from leaves, nodes and stems, plus that from flowers, now indicates without doubt that the Queensland plant belongs in the *Hydnocarpeae,* and is a new genus related to *Trichadenia.* Dr. Dahl has checked my conclusions regarding the pollen evidence."

Dr. Bailey's findings are borne out by the floral structure. The new genus seems very close to *Trichadenia,* which differs in having a calyptrate calyx and stamens with an elongated filament.

Botanic Gardens,
Brisbane, Australia.

BAILEYOXYLON LANCEOLATUM C. T. WHITE

FULL-TONE — MERIDEN

JOURNAL

OF THE

ARNOLD ARBORETUM

VOL. XXII APRIL, 1941 NUMBER 2

GYPSOPHILY AMONG MEXICAN DESERT PLANTS

IVAN M. JOHNSTON

WHILE collecting in northern Mexico I became interested in plants growing on gypsum, and particularly those which appear to be restricted to gypseous soils. Since a goodly number of species appear to prefer gypsum, and some of them even seem to be obligate gypsophiles, I have been surprised to find American botanists have given no particular attention to gypsum as a special plant-habitat. Gypsophilous plants have been ignored by ecologists and plant-geographers, who have failed to recognize them as a small, but very interesting and noteworthy element in the xerophytic floras of northern Mexico and adjacent United States. The present paper is published with the hope of directing attention to this interesting but neglected subject. It is a preliminary report and is concerned only with my observations on the gypsophilous plants of the desert plateau of northern Mexico.

Exposures of gypsum are scattered widely over the intermontane plateau of northern Mexico and northward through New Mexico and western Texas to Colorado and western Kansas. These exposures of hydrous calcium sulphate vary in size from large areas, sometimes covering many square miles, down to small inconspicuous local outcroppings. They may form cliffs, chalky gypsum flats, or, as at the White Sands, N. M., rarely even dunes of gypsum-sand. The erosion of gypsum beds has produced soils containing all possible gypsum mixtures. Though widely distributed, gypsum and gypseous soils are scattered irregularly and frequently they are separated by considerable distances.

If we may judge from their published reports or from the habitat-data found on their herbarium labels, botanists collecting in northern

Mexico have generally failed to recognize gypsum. Plants collected on beds of nearly pure gypsum have had the substratum, if mentioned at all, commonly described as "limy," "calcareous," "chalky" or even "saline." Many references to "dry calcareous soil" undoubtedly refer to gypsum. Beds of gypsum, however, may be recognized after attention has been directed to their peculiarities. Gypsum flats have a soil that is whitish, chalky and friable. They commonly sound with a very characteristic hollow ring when pounded or stamped upon. Large flats, on valley-floors, frequently develop sink-holes, opening into ill defined subterranean water-channels. Small gypsum flats are frequently favored by burrowing rodents and they may be marked by an unusually large number of the mounds of these animals.

The plants found on beds of gypsum are of two sorts, those tolerating gypsum, and those demanding it. The tolerant species, which are numerous, are those of non-gypseous soils which also grow on gypsum and which, though perhaps less abundant on gypsum than elsewhere, seem generally unaffected by the differences of substratum. Of this group only a few, such as *Dyssodia pungens, Coldenia hispidissima, Condalia spathulata,* and *Condalia fasciculata,* may, perhaps, be more thrifty on gypsum than off.

Associated with the species that have spread on to gypseous areas from surrounding non-gypseous soils is the much smaller group of species which are never found beyond the margins of gypseous areas of soil. The most abundant and successful plants found on gypsum exposures commonly belong to this smaller second group of plants.

That there are species strictly confined to gypseous soils is manifest in all exposures of gypsum. In fact, it is often dramatically shown by their abrupt disappearance along the margins of those gypsum flats which are sharply circumscribed. I have seen *Dicranocarpus* abounding on a small flat and so scrupulously respecting the well defined gypsum-margin as to suggest a culture of the plant on a carefully tended garden plot. In northern San Luis Potosí, where species of *Flaveria* and *Sartwellia* are not only confined to gypsum but commonly even abound on it, they frequently color gypsum-flats yellow and permit one to recognize these exposures of gypsum miles away on a distant hillside. Another example of the dramatic way in which species refuse to transgress gypsum-boundaries is found in the behavior of two species of *Fouquieria* growing north of Mohovano, Coahuila. One of these species is frequent on gypsum flats while the other replaces it on the surrounding non-gypseous soils. In a few cases I observed the shrubs growing near one another with interlocking branches, but *F. Shrevei* was always rooted

in gypsum and *F. splendens,* beyond an abrupt gypsum boundary, always rooted in non-gypseous soil.

That there are plants which appear to seek out gypsum and are confined to it is well shown by my experiences in the eastern foothills of the Sierra de las Cruces, Coahuila. Here on a large series of gypsum exposure I found a well developed gypsophilous florula containing species of *Notholaena, Sporobolus, Drymaria, Dicranocarpus, Nama* and *Haploesthes.* Searching out the widely scattered gypsum exposures of the region, with the help of Mr. Robert Stewart, a geologist very familiar with the area, we failed to find any of them that did not bear at least *Nama Stewartii* or *Haploesthes Greggii.* These species grew on gypsum and nothing but gypsum, and showed an almost incredible ability to find widely scattered exposures of gypsum, even the isolated ones and those with a few square yards of surface. Only obligate gypsophily and very successful powers of dissemination can explain the remarkable behavior of these plants.

That there is a group of plants which repeatedly seek out gypsum is further shown by a comparison of the lists of those species found restricted to gypsum in widely separated parts of northern Mexico. The most extensive gypsum deposits which I have examined are those forming the great plains between Matehuala and Cedral, in northern San Luis Potosí. Here are found the following gypsophiles:

Muhlenbergia villiflora	*Nama canescens*
Drymaria lyropetala	*Dicranocarpus parviflorus*
Nerisyrenia gracilis	*Sartwellia humilis*
Dalea filiciformis	*Flaveria anomala*

About 70 miles west of Matehuala, in northern Zacatecas, gypsum exposures near Sierra Hermosa have the following plants restricted to them:

Nerisyrenia gracilis	*Dicranocarpus parviflorus*
Phacelia gypsogenia	*Sartwellia humilis*

Nama hispidum var. *gypsicola*

In southeastern Coahuila, about 70 miles north of Matehuala, the following species were found confined to a gypsum flat just north of La Ventura:

Muhlenbergia villiflora	*Thelesperma scabridulum*
Nerisyrenia gracilis	*Sartwellia humilis*
Dicranocarpus parviflorus	*Flaveria anomala*

Nama hispidum var. *gypsicola*

Nearly 250 miles northwest of La Ventura, in western Coahuila near the southeastern corner of Chihuahua, gypsum flats are frequent between

Mohovano and Laguna del Rey. Here there is a well developed gypsophilous flora containing the following:

Selinocarpus Purpusianus	*Petalonyx crenatus*
Drymaria elata	*Nama Purpusii*
Nerisyrenia Castillonii	*Dicranocarpus parviflorus*
Fouquieria Shrevei	*Sartwellia mexicana*

Over 75 miles northwesterly from the Mohovano-Laguna del Rey area there are gypsum flats south of Jimenez, Chihuahua, bearing the following gypsophiles:

Phacelia gypsogenia *Dicranocarpus parviflorus* *Sartwellia mexicana*

About 75 miles north of Leguna del Rey in western Coahuila, gypseous ridges near Laguna del Jaco produce the following:

Muhlenbergia villiflora	*Nerisyrenia Castillonii*
Sporobolus Nealleyi	*Phacelia gypsogenia*

Sartwellia sp.

East from Laguna del Jaco, in the eastern foothills of the Sierra de las Cruces, there is a well developed gypsophilous florula containing the following:

Notholaena bryopoda	*Nama Stewartii*
Sporobolus Nealleyi	*Dicranocarpus parviflorus*
Drymaris lyropetala	*Haploesthes Greggii*

Further north in western Coahuila, over 100 miles north of Laguna del Rey and about 60 miles south of the Big Bend of the Rio Grande, there are gypsum flats at Castillon containing the following gypsophiles:

Sporobolus Nealleyi	*Nama Stewartii*
Nerisyrenia Castillonii	*Phacelia gypsogenia*
Loeselia Havardii	*Dicranocarpus parviflorus*

Sartwellia puberula

At each of the eight widely separated localities just mentioned, the plants listed were confined to gypsum. A comparison of the lists shows the combinations in which the various gypsophiles are associated in the several floristic areas represented. The presence of various species, frequently with several of the same associates, in widely separated gypsum exposures, is evidence that gypsophily is no matter of individual preference nor chance local association. Only the same fundamental requirements could force the species I have listed to foregather repeatedly and always within the confining limits of scattered gypsum exposures. The behavior of these plants is that of an old and established fraternity. This is also suggested by the fact that all the species of such well marked genera as *Dicranocarpus* and *Sartwellia* are gypsophilous

and is further indicated by the fact that such genera as *Nerisyrenia*, *Drymaria* and *Nama* all have groups of species characterized by gypsophily.

Thus far we have been concerned with the behavior of gypsophiles on exposures of gypsum or on soil mixtures evidently containing a high percentage of gypsum. As has been stated, examination of such deposits shows that certain species repeatedly occur on these deposits and fail to transgress their boundaries when these latter are sharply defined. Gypseous soils, however, may contain varying proportions of gypsum, and gypsum deposits may be partially or wholly covered by a mantle of non-gypseous soil of varying thicknesses, spread by water flowing from slopes beyond the gypsum-boundary.

My observations indicate that a gypsum flat overlaid with a fine completely non-gypseous soil, derived either from calcareous or igneous rocks, is practically devoid of gypsophiles when the non-gypseous mantle becomes as much as an inch in thickness. Sometimes an unbroken overlay of half that thickness appears to be an effective barrier to gypsophilous plants. Since gypsophiles show no particular aversion to non-gypseous material when a certain amount of gypsum is also available, as demonstrated by their frequent presence on mixed soils, and since it would seem that the deep roots of mature gypsophiles would have little difficulty in reaching gypsum through a thin overlying non-gypseous mantle, one can only conclude that the absence of gypsophiles on mantled gypsum is in some way associated with an inability of their seeds to germinate or their seedlings to become established in a completely non-gypseous surface layer of soil.

It is not uncommon to find gypsophiles in mixed soils containing sufficient gypsum characteristically to whiten the soil. Such soils, however, obviously contain a high percentage of gypsum. Observation of the gypsophilous florulas found on mixed soils discloses an obvious correlation between the decrease in number of gypsophiles, both as to individuals and as to species, and the decrease in the evident gypsum-content of these soils. This would indicate that the various gypsophiles differ in the minimum amounts of gypsum they require. This is a subject that merits the attention of an ecologist who can supplement his studies with soil analyses.

While most soils reveal their gypsum content by their pale coloration, there are soils which, though probably containing gypsum, give little or no evidence of the fact superficially. In some cases this is the result of mixing gypsum in a dark-colored soil, mixing in organic material, or masking the pale coloration of gypsum by abundant soil moisture. In

a few cases I have observed gypsophiles growing on soils which I could not identify as gypseous, though I strongly suspect that they are so.

While only chemical analyses will finally settle the matter, a surprisingly strong case of circumstantial evidence can be presented for the presumed occurrence of gypsum in nondescript soils where gypsophytes are found. As an illustration of this, a small terrace adjoining a salt-marsh at Hermanas, Coahuila, may be taken. Here, on a kind of light-colored though not pallid clay, which I did not recognize as gypseous, I found concentrated and localized a number of unusual plants, among which were the following:

Drymaria lyropetala	*Sartwellia mexicana*
Euphorbia astyla	*Thelesperma ramosius*
Nerisyrenia Castillonii	*Aplopappus Johnstonii*
Nama serpylloides var. *velutina*	*? Gaillardia multiceps*

Among this group of plants, the presence of the *Drymaria* and the *Nerisyrenia* is especially noteworthy, for these plants have been discovered elsewhere only on gypsum and are very marked gypsophiles. Habitat data are not at hand for all the available collections of the *Sartwellia,* but most of these are definitely known to have come from gypseous soil, and, from collateral evidence, a gypsum substratum can be confidently assumed for the rest. Hence among the plants congregating on the small terrace near Hermanas there are three species, which, if we may judge from their behavior elsewhere, might be taken as good indicators of gypseous soil. If the small terrace at Hermanas is gypseous, we have a reason for the remarkable concentration of rare plants in this small area. There is, indeed, evidence for believing that all of them are gypsophiles. It would not be surprising if the new *Thelesperma,* found only at Hermanas, proved to be gypsophilous. The genus *Thelesperma* has reacted to gypsum elsewhere; *T. scabridulum* is a marked gypsophile and is known only from a single gypsum flat in southern Coahuila. Among the other new plants found near Hermanas were the *Nama* and the *Aplopappus.* These, and the rare *Euphorbia,* I subsequently found a second time on the saline flat west of Cuatro Cienegas. It is interesting to note that near the margin of this saline flat, not far from where I found the *Nama,* the *Aplopappus* and the *Euphorbia,* I found colonies of *Nama Purpusii,* which is a characteristic gypsophile in the extensive gypsum flats, further west, about Laguna del Rey, where, incidentally, the *Euphorbia* has also been found. I am inclined, also, to attach significance to the fact that near the *Nama, Aplopappus* and *Euphorbia* at Cuatro Cienegas, I found a remarkable new species of *Nerisyrenia* (*N. incana*). Of the four other species

of this genus, three are marked gypsophiles. The odds, therefore, are in favor of *N. incana* also being gypsophilous. The presence of the gypsophilous *Nama Purpusii* in its vicinity seems to make this very probable. In any case, there are reasons for suspecting that gypsum is present west of Cuatro Cienegas. This appears to be the reason why the three rare plants of the supposed gypseous terrace at Hermanas should again appear together, sixty miles to the westward, in the saline flats near Cuatro Cienegas. The rare species localized on the terrace at Hermanas behave, individually and as a group, as gypsophiles. As gypsophiles their presence together, congregated on the small terrace at Hermanas, is understandable if the soil at that particular locality is gypseous. I believe that the congregation of these species indicates the presence of gypsum in the soil, and I am confident that soil analyses would substantiate my faith in the indicator value of these species.

If the localities near Hermanas and Cuatro Cienegas have gypseous soils, they are localities of interest. At both of them, the soils, in addition to their suspected gypsum content, evidently contained large amounts of other salts. Near Cuatro Cienegas the putative gypsophiles were actually associated with pronounced halophytes, such as *Distichlis, Monanthochloe, Suaeda, Atriplex* and *Allenrolfea*. This is the only locality at which I have found possible gypsophiles associating with pronounced halophytes. This would suggest that perhaps some gypsophiles, with their basic requirements of gypsum satisfied, can grow in mixed soils rich enough in other salts to support halophytic plants as well.

Some authors have referred to the plants found growing on gypsum as "halophytes." This is incorrect. If the conventional definition of halophyte, "a plant growing on soils impregnated with salt or alkali," can be stretched to include gypsophiles (plants of calcium sulphate), I do not see why the term can not be made entirely meaningless by including the plants of calcium carbonate, the calciophiles, as well. While some gypsophiles do appear to tolerate concentrations of salt and alkali and might be termed "halophytic gypsophiles," most of them grow on beds of gypsum where the concentrations of salt and alkali are frequently even lower than in the average of desert soils. Beds of gypsum do not produce the common and distinctive plants of salt and alkali flats. With adjacent non-gypseous slopes and flats, they share in the common and widespread species of the region, and their peculiar species have been recruited from among this class of plants. Perhaps the gypsophiles average a bit more succulent, but as a class they are not otherwise dis-

tinguished superficially from the common widely ranging desert plants growing with them on and about gypsum exposures.

Gypsophiles may belong to genera also containing species of common unspecialized desert plants, and even to genera containing more than one gypsophilous species, but only exceptionally do they belong to groups containing halophytes. In their basic requirements and in their phyletic relations gypsophiles and halophytes are fundamentally different. The few exceptions are of interest. The genus *Frankenia* is generally recognized to be an old group and has species widely scattered in the various desert regions of the world. Though most of its species are marked halophytes, the genus does contain some recognized gypsophiles, the two in America being confined to the plateau desert of northern Mexico and to the adjoining, physiographically similar, area to the north. The genus *Sporobolus*, which has a gypsophile in *S. Nealleyi*, also contains some marked halophytes. As a group, however, it is more characteristic of arid regions rather than of halophytic situations. Perhaps also to be included here is an aberrant and curious species of *Atriplex*, *A. reptans*, recently discovered on a flat at the base of a gypseous ridge near Laguna del Jaco, Coahuila. Should this *Atriplex* prove to be gypsophilous, it will be the only Mexican member of that great group of halophytes, the Chenopodiaceae, which is confined to gypseous soils.

It is natural to expect that, if gypsophily is markedly developed in northern Mexico, evidences of it should be found among the plants in the adjoining and physiographically similar parts of the United States. Casual notes in the literature and habitat-data on herbarium specimens suggests that there are a number of gypsophiles in the United States which do not extend south to the Mexican border. I know of only two localities north of the border at which the plants on a gypsum habitat have been described. Both are in New Mexico. Their flora is similar to that which I have described from Mexico.

Probably the most famous deposit of gypsum in the United States is the so called "White Sands" of New Mexico. In a recent account of these gypsum dunes, F. W. Emerson, Ecology **16**: 226–233 (1935), lists 57 species as growing in the gypsum sand. Among the species listed are: *Sporobolus Nealleyi, Nerisyrenia linearifolia, Nama* (*Andropus*) *carnosum, Dicranocarpus parviflorus,* and *Sartwellia Flaveriae*. The *Sporobolus* and *Dicranocarpus* are very definitely restricted to gypsum or gypseous soils in Mexico. The *Nama* is closely related to a group of Mexican gypsophiles, and away from the White Sands is known only from two collections in northern Culberson County, Texas. This latter area is a region of very extensive gypsum deposits, exposures of gypsum

fifty feet thick having been reported in the bluffs of Delaware Creek where this *Nama* has been collected. The *Nerisyrenia* was first collected on the bluffs of Delaware Creek, and has been subsequently found in various parts of adjacent southeastern New Mexico where Wooton & Standley, Fl. New Mex. 270 (1915), report it as a plant of "gypsum soils." It is closely related to the Mexican gypsophile *N. gracilis*. Away from the White Sands the *Sartwellia* has been collected repeatedly in gypseous soil and is probably gypsophilous as are the other, all Mexican, members of its genus. Hence at the White Sands we have growing on gypsum a number of species that are either specifically identical or are closely related to Mexican gypsophiles. Evidence indicates that the latter group may be as strictly confined to gypseous soils as are their Mexican relatives. Other gypsophiles, representing floristic elements not extending into Mexico, are probably also present on the White Sands. Very likely among these are *Selinocarpus lanceolatus*, *Frankenia Jamesii*, and *Pseudoclappia arenaria* (*"Clappia suaedaefolia"*).

The flora of some extensive gypsum flats, lying beyond the San Andreas Mts. and west of the White Sands, have recently been described by R. S. & I. F. Campbell, Ecology **19**: 572–577 (1938). In their account of the "Vegetation on gypsum soils of the Jornada Plain, New Mexico," they state that only eight phanerogams were found on the gypsum flats described; namely, *Ephedra Torreyana*, *Sporobolus Nealleyi*, *Pappophorum Wrightii*, *Oenothera Hartwegii*, *Gaura coccinea*, *Solanum Jamesii*, *Sartwellia Flaveriae*, and *Dicranocarpus parviflorus*. Except for the *Ephedra*, the *Solanum*, and the *Sartwellia*, which extend scarcely if at all into Mexico, any of these species may be expected on gypsum flats south of the boundary. Of the list only the *Pappophorum*, *Gaura* and *Solanum* are unreported from the White Sands. Concerning the eight species on the Jornada Plain the authors state that only the *Sporobolus* and the *Gaura* "appear to be limited to the gypsum soils." This must refer only to the areas on the Jornada Plain having maximum gypsum concentration. Both the *Sporobolus* and *Dicranocarpus* are characteristic gypsophiles in Mexico, and *Sartwellia Flaveriae* gives evidence elsewhere of sharing gypsophily with its Mexican congeners. At the three localities where I have seen the *Sporobolus* in Mexico it was confined to concentrated gypsum. The *Dicranocarpus* and the Mexican species of *Sartwellia*, on the other hand, though abounding on gypsum, frequently grow on mixed soils. I have no doubt that the behavior of these gypsophiles at the Jornada is similar to that I have observed in Mexico.

The study of the florulas of the two gypsum beds in New Mexico, just

mentioned, and of all available bits of information concerning the plants found on gypsum-soils in the Southern Great Plains Province, seems to indicate that gypsophily is largely confined there to groups of species recognizable as "southern" or "Mexican" elements in the flora. The plateau deserts of northern Mexico seem to be a center for gypsophiles and perhaps even a center from which they may have spread northward. In any case Texas and New Mexico appear to be a promising field for the study of gypsophiles in the United States. Many promising sites for such studies are described in R. W. Stone's "Gypsum deposits of the United States," U. S. Geol. Surv., Bull. **697:** 1–336 (1920).

ENUMERATION OF SPECIES

In the following catalogue I have listed systematically those plants of the plateau deserts of northern Mexico which are gypsophiles or are suspected gypsophiles. Because of their close relationships with certain Mexican gypsophiles, several gypsophilous species confined to Texas and New Mexico have also been included. Under each species treated I have cited collections examined. Most of these are in the Gray Herbarium (G). Some, however, are from the U. S. National Herbarium (US), and represent portions of a loan kindly sent me by the curator, Dr. W. R. Maxon. Dr. J. R. Swallen has not only critically determined the two grasses, but has also supplied me with a list of the collections by which they are represented in the National Herbarium. On his authority I have included these among the specimens cited.

Notholaena bryopoda Maxon, Proc. Biol. Soc. Wash. **18:** 205 (1905).

NUEVO LEON: base of the Sierra de San Lorenzo, chalky banks, 7500 ft., Nov. 7, 1907, *Pringle 8802* (G, ISOTYPE). COAHUILA: foothills of the Sierra de la Cruces west of Santa Elena Mines, confined to gypsum, locally abounding on flats and on banks of arroyos, about 5500 ft., Aug. 13, 1940, *Johnston & Muller 243* (G).

On the gypsum flats about a mile west of Santa Elena Mines this fern is localized and very common on gypsum. It grows on gypsum flats and on the banks of ravines cut through them, commonly forming dense clumps up to a meter in diameter. In its obvious restriction to gypsum and in its great abundance and vigorous growth on that substratum, it gives every evidence of being a gypsophile. Mr. C. A. Weatherby, who is monographing *Notholaena,* knows of only one other collection of this well marked species, the type-collection made nearly forty years ago in the mountains of southern Nuevo Leon, 15–20 miles south of Doctor Arroyo and not far from the Tamaulipas boundary. At this locality in

Nuevo Leon the fern was collected on "chalky banks." Since dry gypsum is "chalky" and since the fern was confined to gypsum near Santa Elena Mines, I believe it may be accepted as more than merely probable that the original material of *N. bryopoda* was found on a gypsum bank. This fern is probably gypsophilous.

Muhlenbergia villiflora Hitchc. N. Am. Fl. **17:** 470 (1935).

TAMAULIPAS: "Cañon de las Minas et Victoria inter Michiguana et Tanquecillos," *Karwinsky 1012* (US, frag. of type). SAN LUIS POTOSÍ: Charcas, *Lundell 5440* and *Whiting 786* (US); 6 mi. north of San Vicente, gypseous soil, 1938, *Johnston 7615* (G, US). NUEVO LEON: Galeana, bank of stream, *Chase 7689* (G, US); near Pablillo, edge of cienega, 1940, *Shreve & Tinkham 9749* (G). COAHUILA: 6 mi. north of La Ventura, gypsum flat, 1938, *Johnston 7642* (G, US); 10 mi. east of Fraile, with *Stipa*, abounding on floor of valley, 1938, *Johnston 7305* (G, US); gypseous ridge east of Laguna del Jaco, 1940, *Johnston & Muller 1074* (G, US).

I am indebted to Dr. J. R. Swallen for the identification of this species and for data on the specimens of it represented at Washington. Most of the collections cited have been incorrectly identified as "*M. Thurberi.*"

This species is definitely confined to gypsum at four out of the nine stations at which it is known. At these stations the plant behaved as a marked gypsophile. Although the nature of the soil was not noted, the local abundance of the grass in the valley between Carneros Pass and Fraile might well be caused by the presence of gypseous soil. Various gypsophiles have been collected near Pablillo. Gypseous soils are common and widely distributed in northern San Luis Potosí and are to be expected near Charcas. I believe that this grass is gypsophilous.

Sporobolus Nealleyi Vasey, Contr. U. S. Nat. Herb. **1:** 57 (1890).

COAHUILA: gypseous ridge east of Laguna del Jaco, 1940, *Johnston & Muller 1073* (G); foothills of Sierra de las Cruces west of Santa Elena Mines, gypsum flats, 1940, *Johnston & Muller 247* (G); Castillon, gypsum flat, 1940, *Johnston & Muller 1268* (G).

TEXAS: Monahans, Ward Co., very sandy belt, *Silveus 759* (US); Monahans, alkali flat, *Silveus 784* (US); 15 mi. south of Stanton, ? Midland Co., *Tharp 5000* (US); Screw Bean, Reeves Co., Sept. 1893, *Nealley 2305* (G, US); valley of the Pecos, *Wright 727* (G). NEW MEXICO: 35 mi. south of Torrance, Lincoln Co., 1909, *Wooton* (US); San Ysidro, *Arséne 19040* (US); Manzano Nat. Forest, near White Well no. 2, Torrance Co., Forest Service no. 39515, legit *Talbot* (US); near Suwanee, 1906, *Wooton* (US); Arroyo Ranch near Roswell,

Chaves Co., *Griffiths 5759* (G, US); Jornado Range Reserve, in caliche east of Middle Well, Forest Service no. 49290, legit *Schoeller & Campbell 462* (US); on the white sands, Dona Ana Co., *Wooton 160* (G, US).

Where I have seen this grass in Mexico it was very obviously confined to gypsum. Hitchcock, Manual of Grasses, 406 (1935), states that it is a plant of "gypsum sands" in Texas and New Mexico. Wooton & Standley, N. Mex. Agr. Experiment Station Bull. **81**: 84 (1911), state that "it never occurs on anything but 'gyp' soils," being "found only on soils containing large quantities of gypsum." Many of the localities in Texas and New Mexico, represented by the specimens cited above, are those where other gypsophiles have been obtained, and most of them are in areas in which extensive gypsum exposures are known. All the evidence indicates that the species is a marked gypsophile.

Atriplex reptans Johnston, Jour. Arnold Arb. **22**: 111 (1941).

COAHUILA: flats at the base of the gypsum ridge east of Laguna del Jaco, 1940, *Johnston & Muller 1080* (G) and *1081* (G, TYPE).

This remarkable *Atriplex* was locally very abundant in a narrow belt at the base of a gypsum ridge. It was the dominant and by far the most conspicuous plant in the scant flora at this locality. It was not seen elsewhere. The species is probably gypsophilous.

Selinocarpus Purpusianus Heimerl, Oesterr. Bot. Zeitschr. **63**: 353 (1913).

COAHUILA: 16 mi. south of Laguna del Rey, road to Mohovano, confined to gypsum flats, *Johnston 7807* (G); Sierra del Rey, 1910, *Purpus 4505* (G, ISOTYPE).

This plant was uniformly associated with *Fouquieria Shrevei* and *Petalonyx crenatus* in the region about Laguna del Rey, and like these species always growing on gypseous soil. The plant is a marked gypsophile.

The genus *Selinocarpus* has more than one gypsophile. *Selinocarpus lanceolatus* Wooton is definitely gypsophilous. It is known only from the White Sands of New Mexico and to the south, in the great gypsum area in northeastern Hudspeth County, Texas. *Selinocarpus Palmeri* Hemsl., known only from San Lorenzo de la Laguna, Coahuila, may possibly be another.

Anulocaulis leiosolenus (Torr.) Standley, Contr. U. S. Nat. Herb. **12**: 373 (1909).

TEXAS: Tornillo Creek, Brewster Co., 1883, *Havard* (US); 5¼ mi. E. of Terlingua, 1938, *Cory 30251* (G); bluffs of Delaware Creek, 1881,

Havard 87 (G); Millers Bros. Ranch, Culberson Co., 1928, *Cory 1532* (G).

The type of this species is given as collected by Parry in the "Great Canyon of the Rio Grande, 70 miles below El Paso, in gypseous soil." This is probably the canyon of the Rio Grande at the southeast corner of Hudspeth County, Texas. Gypseous soils are known in Tornillo Creek, and, of course, gypsum occurs in unusual abundance in northern Culberson County where Havard and Cory have collected the plant. The species is almost certainly a gypsophile. The plants of Nevada, which have been referred to *Anulocaulis leiosolenus* represent a well marked, undescribed species.

Drymaria lyropetala Johnston, Jour. Arnold Arb. **21**: 68 (1940).

San Luis Potosí: 3.5 km. south of Cedral, gypsum flats, 1938, *Johnston 7594* (G, type); 63 km. south of Matehuala, gypsum flats, 1938, *Johnston 7513* (G). Coahuila: 1 mi. south of Hermanas, locally common in heavy alkaline soil, 1938, *Johnston 7064* (G); foothills of the Sierra de las Cruces west of Santa Elena Mines, local on gypsum flats, 1940, *Johnston & Muller 241* (G).

This species is probably a pronounced gypsophile. At three of the four localities at which it has been collected it was definitely confined to gypsum. As has been discussed earlier in this paper, the locality at Hermanas is probably gypseous also.

Drymaria elata Johnston, Jour. Arnold Arb. **21**: 68 (1940).

Coahuila: 10 km. south of Laguna del Rey, local in gypseous silt, 1938, *Johnston 7823* (G, type); Sierra del Rey, 1910, *Purpus 4496* (G).

This species is endemic to the region about Laguna del Rey where I found it only on gypseous soils. I believe it may be accepted as a marked gypsophile.

Drymaria suffruticosa Gray, known only from San Lorenzo de la Laguna, Coahuila, is a close relative of *D. elata* with which it may share gypsophily. Various gypsophiles have been collected at San Lorenzo.

Nerisyrenia gracilis, sp. nov.

Planta humilis perennis multicaulis gracilis, maturitate pilis stellatis sparse vestitas grisella; caulibus gracilibus numerosis 1–2 dm. longis decumbentibus saepe longiramosis; foliis linearibus 2–5 cm. longis saepe 1–1.5 mm. raro ad 2 mm. latis; sepalis oblongis ad 6 mm. longis 1.5 mm. latis; petalis albis ad 9 mm. longis obovatis supra medium ad 4.5 mm. latis deinde basim versus in unguiculum ad 1.5 mm. longum ad 1.3 mm. latum margine denticulatum contractis; pedicellis 5–10 mm. longis

decurvatis vel recurvatis; siliquis 1–2 cm. longis curvatis paullo compressis ca. 1 mm. altis et 1.25 mm. crassis, in racemis breviter pedunculatis terminalibus 1–5 cm. longis gestis; stylo 2.5–3 mm. longo; ovulis 60–100; seminibus compresse ellipsoideis ad 0.8 mm. longis ca. 0.5 mm. latis.

SAN LUIS POTOSÍ: 38 mi. south of Matehuala, gypsum flat, 1938, *Johnston 7509* (G); 5 mi. south of Cedral, gypsum plain, 1938, *Johnston 7525* (G); 2 mi. south of Cedral, gypsum plain, 1938, *Johnston 7583* (G, TYPE); 6 mi. north of San Vicente, gypseous soil, 1938, *Johnston 7616* (G). ZACATECAS: Hac. de Sierra Hermosa, gypsum bank, 1938, *Johnston 7402* (G). COAHUILA: 6 mi. north of La Ventura, gypsum flat, 1938, *Johnston 7638* (G).

This well marked species most suggests *N. linearifolia* of gypsum soils in New Mexico and Texas, from which it differs in being a low, spreading and herbaceous, rather than an erect, tall, frutescent plant, and in having shorter less exserted inflorescences, smaller corollas, longer styles, and weakly compressed fruits. The plant is a marked gypsophile. All the known collections of the species were obtained from gypseous soils, and at all the known stations it was confined to that substratum.

Nerisyrenia linearifolia (Wats.) Greene, Pittonia **4:** 225 (1900).

NEW MEXICO: White Sands, Otero Co., *Wooton 158* (G, US) and *Wooton 2781* (US); Lakewood, Eddy Co., 1909, *Wooton* (US); plains 35 mi. south of Torrance, Lincoln Co., 1909, *Wooton* (US); road between Fort Sumner and Roswell, sandy roadside, *Nelson 11311* (G). TEXAS: bluffs of Delaware Creek, Culberson Co., 1882, *Havard 221* (G, TYPE).

In their Flora of New Mexico, Wooton & Standley, Contr. U. S. Nat. Herb. **19:** 270 (1915), state that this is a plant of "gypsum soils." The type-locality in western Texas, near the New Mexico line, is in an area of extensive gypsum deposits. The species, like its Mexican relative, *N. gracilis*, is evidently a gypsophile.

Nerisyrenia Castillonii Rollins, Contrib. Dudley Herb. **3:** 181 (1941).

COAHUILA: 16 mi. south of Laguna del Rey, gypsum plain, 1938, *Johnston 7814* (G); 1 mi. south of Hermanas, dry heavy alkaline soil on terrace, *Johnston 7067* (G); gypseous ridges east and south of Laguna del Jaco, 1940, *Johnston & Muller 1078* and *1099* (G); Castillon, gypsum flat, *Johnston & Muller 1264* (G, TYPE).

This newly described species resembles *N. camporum* var. *angustifolium* Coult., but is a perennial and has subterete rather than compressed fruit. Except those from near Hermanas, the above-cited speci-

mens were all obtained from soils recognized as gypseous. The soil at this locality, as discussed earlier in this paper, is probably gypseous also. The species is apparently gypsophilous.

Nerisyrenia incana Rollins, Madroño **5**: 132 (1939).

COAHUILA: 4 mi. west of Cuatro Cienegas, alkaline flats, 1938, *Johnston 7130* (G, TYPE).

This species may be gypsophilous, as are all the other species of the genus, save only *N. camporum*. Plants found near it, in and adjacent to the saline flats, seem to indicate the soil at this locality may be gypseous.

Dalea filiciformis Robins. & Greenm. Proc. Am. Acad. Sci. **29**: 382 (1894).

NUEVO LEON: foothills below Pablillo, 15 mi. sw. of Galeana, abundant over small areas in pinyon-belt, 1934, *Muller 530* (G). SAN LUIS POTOSÍ: 2 mi. south of Cedral, gypsum plain, 1938, *Johnston 7585* (G); 35 mi. south of Matehuala, gypsum flats, 1938, *Johnston 7516* (G); Villar, limestone hills, 1893, *Pringle 5472* (G, TYPE); Minas de San Rafael, 1910, *Purpus 4834* (G). AGUASCALIENTES: Aguascalientes, *Rose & Haye 6204* (G) and *Rose & Painter 7706* (G). HIDALGO: El Salto, dry calcareous soil, 1904, *Pringle 11959* (G); Tula, 1905, *Rose, Painter & Rose 8315* (G). FEDERAL DISTRICT: above Santa Fe, thin gravelly soil, *Pringle 8522* (G). PUEBLA: near El Riego, Tehuacan, *Rose & Painter 10010* (G); *Purpus 1204* (G); vicinity of Puebla, Acatzinco, *Arséne 3570* (G).

At the two localities where I have collected this plant, south of Cedral and Matehuala, it grew only in pure gypsum. The behavior of the plant at these localities was that of a pronounced gypsophile. Most of the collections above cited have no habitat data. It is to be noted, however, that Pringle's collection from Hidalgo is given as from "dry calcareous soil," a descriptive phrase which various botanists have applied to gypseous soils. The collection from Nuevo Leon, from the area about Pablillo where various gypsophiles have been collected, probably came from gypsum, and I suspect that most of the collections cited from central Mexico may have come from that substratum. The plants from the state of Puebla are more fruticulose, more branched and have fewer leaflets than the other material cited. Perhaps they should not be included in the above enumeration of specimens.

Euphorbia astyla Engelm. ex Boiss. in DC. Prodr. **15**^{2}: 40 (1862).

TEXAS: Pecos County, July 21, 1928, *Cory 1960* (G).

COAHUILA: 1 mi. south of Hermanas, heavy alkaline soil, 1938, *Johnston 7060* (G); 3 mi. west of Cuatro Cienegas, saline flats, 1938, *Johnston 7135* (G); 3 mi. south of Cuatro Cienegas, salt land, 1939, *White 1924* (G); Sierra del Rey, 1910, *Purpus 4512* (G). DURANGO: valley of the Nazas, April 15, 1847, *Gregg 457a* (G, TYPE).

This plant is probably a halophytic gypsophile. The associates of this species have been discussed earlier in this paper.

Frankenia gypsophila Johnston, Jour. Arnold Arb. **20:** 237 (1939).

SAN LUIS POTOSÍ: 6 mi. north of San Vicente, local on gypseous soil, 1938, *Johnston 7614* (G, TYPE).

This remarkable species is known only from the type-collection which was obtained from a colony localized on gypseous soil. One of its closest American relatives, *F. Jamesii* Torr. of Texas, New Mexico and Colorado has been collected on gypsum and may also be gypsophilous.

Petalonyx crenatus Gray ex S. Wats. Proc. Am. Acad. **17:** 358 (1881–82).

COAHUILA: San Lorenzo de la Laguna, 1880, *Palmer 853* (G, TYPE); Sierra del Rey, sandy plains, 1910, *Purpus 4466* (G); 16 mi. south of Laguna del Rey, confined to gypsum flats, 1938, *Johnston 7808* (G); about 30 mi. south of Sierra Mojada, 1937, *Wynd 769* (G); 21 mi. west of El Oro, 1939, *White 2006* (G).

The collections by Purpus and by Wynd come from the region about Laguna del Rey where I have observed the plant and found it confined to gypseous soils. There is probably gypsum at San Lorenzo de la Laguna. Several of the species found confined to gypsum in the area between Mohovano and Laguna del Rey are otherwise known only from collections made by Palmer at San Lorenzo de la Laguna.

Fouquieria Shrevei Johnston, Jour. Arnold Arb. **20:** 238 (1939).

COAHUILA: road to Mohovano, 16 mi. south of Laguna del Rey, confined to gypsum flats, 1938, *Johnston 7815* (G, TYPE); San Lorenzo de la Laguna, 1880, *Palmer 2001* (G).

This species was observed at various places between Mohovano and Laguna del Rey and was always confined to gypseous soils. I believe that the species may be accepted as a marked gypsophile.

Loeselia Havardii Gray, Proc. Am. Acad. Sci. **19:** 87 (1883).

TEXAS: 12 mi. south of Persimon Gap, Brewster County, *Cory 18709* (G).

CHIHUAHUA: Presidio del Norte [Ojinaga], March 1881, *Havard*

247 (G, TYPE). COAHUILA: Castillon, confined to gypsum flats, 1940, *Johnston & Muller 1263* (G).

The species was clearly confined to gypsum at Castillon. Gypseous soils are frequent about Ojinaga and in the Big Bend area of Texas where the species has also been collected. I believe that the species is gypsophilous.

Nama Stewartii Johnston, Jour. Arnold Arb. **22**: 114 (1941).

COAHUILA: south base of Picacho de San José, southeastern foothills of Sierra de las Cruces, gypsum flats and cliffs, 1940, *Johnston & Muller 814* (G, TYPE); eastern foothills of Sierra de las Cruces west of Santa Elena Mines, gypsum flats, 1940, *Johnston & Muller 228* (G); Castillon, confined to gypsum flats, 1940, *Johnston & Muller 1271* (G); between Carrizo and Carricito, gypseous ridge, 1940, *Johnston & Muller 159* (G); Picachos Colorados, slope at west end of cliffs, 1940, *Johnston & Muller 139* (G).

The material from the Sierra de las Cruces and that from Castillon was collected in pure gypsum, and that from between Carrizo and Carricito came from pale evidently gypseous soil. Sr. Tirso Castillon informs me that gypsum crops out from under the red cliffs of the Picachos Colorados near the place where I collected the plant. The species is a marked gypsophile.

Nama Havardii, of the Big Bend area, in Brewster County, Texas, is most closely related to *N. Stewartii*. It occurs in a region containing gypseous soil and some of the collections of the plant are given as from that substratum. The species is to be expected on the Mexican side of the Rio Grande and may prove to be a gypsophile.

Nama Purpusii Brandegee, Univ. Calif. Publ. Bot. **4**: 186 (1911).

COAHUILA: Mohovano, 1910, *Purpus 4562* (UC, TYPE); 16 mi. south of Laguna Del Rey, on road to Mohovano, gypsum plain, 1938, *Johnston 7812* (G); 5 mi. west of El Oro, 1939, *White 2003* (G); 4 mi. west of Cuatro Cienegas, 1938, *Johnston 7141* (G).

Gypsum deposits are very common between Mohovano and El Oro and the collections of Purpus and White may well have come from gypsum, for in the same region, south of Laguna del Rey, I observed the plant only on gypsum flats. The collection from west of Cuatro Cienegas came from local colonies of the plant in barren grayish silt among the desert scrub not far from the edge of the salt-marsh in which a number of suspected halophytic gypsophiles were found. The plants from near Cuatro Cienegas, hence, probably grew in gypseous soil. I believe that *Nama Purpusii* is gypsophilous.

Nama stenophyllum Gray is a close relative of *N. Purpusii*. It is known only from about 25 mi. northeast of Parras, about the base of the Parras Mts., and near Viesca. Like its relative, the species may be gypsophilous.

Nama canescens C. L. Hitchc. Amer. Jour. Bot. **26**: 345 (1939).

SAN LUIS POTOSÍ: 38 mi. south of Matehuala, gypsum plain, 1938, *Johnston 7510* (G, TYPE); 2 mi. south of Cedral, gypsum plain, 1938, *Johnston 7584* (G).

Both of the known collections of this species were discovered on concentrated gypsum. The plant is a marked gypsophile.

Nama serpylloides Gray var. **velutina** C. L. Hitchc. Amer. Jour. Bot. **26**: 342 (1939).

COAHUILA: 2 mi. west of Cuatro Cienegas, bank of very alkaline soil, edge of salt-marsh, 1938, *Johnston 7126* (G); 1 mi. south of Hermanas, dry heavy alkaline soil on terrace near salt-marsh, 1938, *Johnston 7063* (G, TYPE).

I believe that this plant is a halophytic gypsophile. The cited material, all that is known of the variety, was collected before I had come to recognize gypsum as a special habitat. The chalky mounds on which the *Nama* was growing west of Cuatro Cienegas were probably gypseous. My reasons for believing that the locality near Hermanas was also gypseous have been discussed earlier in this paper.

Nama hispidum Gray var. **gypsicola**, var. nov.

A forma typica differt caulibus gracilibus 5–18 cm. longis 0.5–1.5 mm. crassis valde depressis sparse strigosis; foliis acutiusculis linearibus 0.7–1 mm. latis 5–12 mm. longis pilos rigidos sparsos gerentibus margine incrassatis; limbo corollae 5–7 mm. diametro.

ZACATECAS: Hac. de Sierra Hermosa, prostrate on gypsum banks, 1938, *Johnston 7406* (G). COAHUILA: 6 mi. north of La Ventura, rare on gypsum flats, plant depressed-spreading, corolla blue-purple, Sept. 13, 1938, *Johnston 7633* (G, TYPE).

The very slender depressed strigose stems and the very narrow elongate sparsely strigose leaves readily separate these two collections from all the many specimens of *N. hispidum* and varieties as represented in the Gray Herbarium. The two collections were both localized on gypsum and, though collected over a hundred miles apart, are so similar in aspect as well as in details, that they might pass as parts of a single collection. Hitchcock, Amer. Jour. Bot. **26**: 347 (1939), commented

on their peculiarities but gave them no name. They evidently represent a marked gypsophilous variation of the species.

Nama carnosum (Wooton) C. L. Hitchc. Amer. Jour. Bot. **26**: 345 (1939).

New Mexico: White Sands of Dona Ana County, *Wooton 164* (US, type).

Texas: bluffs of Delaware Creek, Culberson Co., *Havard 15* (G); Millers Ranch, Culberson Co., gypsum ridge, June 17, 1928, *Cory 2291* (G).

This is a marked gypsophile. The presence of the species on the White Sands and on the gypsum ridge near Millers Ranch as well as its presence on the bluffs of Delaware Creek, where thick beds of gypsum are exposed, is indicative of its soil requirements.

Nama flavescens Brandegee is a Mexican relative of *N. carnosum*. It has been collected near Parras and near San Lorenzo de la Laguna in Coahuila, and near Cedros in Zacatecas. Various pronounced gypsophiles have been collected near San Lorenzo and near Cedros. The species may possibly be a gypsophile.

Phacelia gypsogenia, sp. nov.

Planta erecta rigida 2–4.5 dm. alta infra medium simplex supra medium ramulos ascendentes 1–2 dm. longos gerens glandulifera hispidula; caulibus hispidulis minute adpresseque villosulis viscidis basim versus 3–5 mm. crassis; foliis inferioribus sub anthesi delapsis; foliis mediis et superioribus numerosis viridibus sparse hispidulis viscidis 3–6 cm. longis 1–1.5 cm. latis conspicue irregulariter lobatis; lobis foliorum saepe utroque 5–7 irregulariter eroso-dentatis vel inciso-lobulatis; spicis numerosis densis multifloris solitariis vel geminatis, maturitate saepe ca. 5 cm. longis sed non raro duplo vel triplo longioribus ad 8 mm. latis; lobis calycis oblanceolatis vel late oblanceolatis hispidulis glanduliferis, ad anthesim 3–4 mm. longis et 1–1.5 mm. latis, fructiferis ad 5 mm. longis et 1.2–1.8 mm. latis; calycibus fructiferis subglobosis; corolla subtubulari dilute lavendulacea marcescente ca. 5.5 mm. longa imam ad basim 1.5 mm. crassa, supra (infra lobis) 2.5 mm. crassa; limbo ca. 3 mm. diametro; lobis ascendentibus vel stricte ascendentibus glaberrimis ad 2 mm. longis et latis apice rotundis margine erosis vel raro integris; filamentis ca. 1 mm. supra basim corollae affixis ca. 7 mm. longis longe exsertis; appendiculis staminalibus ad 0.8 mm. longis basim versus latioribus (ca. 0.3 mm. latis) deinde apicem versus gradatim angustioribus, basi abrupte contractis rotundis; stylis 7–8 mm. longis ad 2–2.5 mm. supra basim connatis et sparse hispidulis deinde liberis

et glabris; ovario supra medium dense hispidulis; capsula subglobosa ad 2.5 mm. longa glandulifera supra medium sparse antrorse hispidula; seminibus 4, foveolatis ca. 2.5 mm. longis et 1.5 mm. latis, dorse convexis haud corrugatis, ventre excavatis, marginem versus carinae medialis prominentibus et nuculae latus inferius versus aliquantum tumulosis.

ZACATECAS: Hac. de Sierra Hermosa, local on gypsum banks, 1938, *Johnston 7403* (G). CHIHUAHUA: 5 mi. south of Jimenez, gypsum flat, 1938, *Johnston 7843* (G). COAHUILA: gypseous ridge east of Laguna del Jaco, 1940, *Johnston & Muller 1072* (G); Castillon, on gypsum flats, 1940, *Johnston & Muller 1266* (G, TYPE).

This very distinctive plant belongs to the group of *Phacelia integrifolia* Torr., in which it is characterized by its stiff erect habit, grayish viscid hispidulous stems, irregularly much dissected elongate leaves, small fruits, small hispidulous subglobose calyx, and small subtubular glabrous corollas.

The plant is a marked gypsophile. At all the four localities at which it has been found it very definitely grew on gypsum and was obviously confined to gypseous soil.

Aplopappus Johnstonii Blake, Proc. Biol. Soc. Washington **54**: 18 (1941).

COAHUILA: 1 mi. south of Hermanas, dry heavy alkaline soil, 1938, *Johnston 7066* (G); 4 mi. west of Cuatro Cienegas, alkaline flat, 1938, *Johnston 7131* (G).

Though the substratum of the plants was not recognized as gypseous when the specimens were collected, as has been discussed earlier in this paper, I now believe that the plant was growing in gypsum-containing soil. I believe that this bizarre species is a gypsophile.

Dicranocarpus parviflorus Gray, Mem. Am. Acad. Sci. n.s. **5**: 322 (1854).

SAN LUIS POTOSÍ: 35 mi. south of Matehuala, gypsum flat, 1938, *Johnston 7514* (G); 2 mi. south of Cedral, gypsum flat, 1938, *Johnston 7588* (G); near Salado, gypsum plains, 1939, *Shreve 9353* (G); Catorce, alkaline plain, 1934, *Lundell 5736* (US). ZACATECAS: Sierra Hermosa, gypsum banks, 1938, *Johnston 7407* (G); Hac. de Cedros, on flats, a garden pest, 1908, *Lloyd 173* (US). DURANGO: Mapimi, cultivated fields, *Palmer 537* (G, US). COAHUILA: 6 mi. north of La Ventura, gypsum plain, 1938, *Johnston 7641* (G); 16 mi. south of Laguna del Rey, gypsum plain, 1938, *Johnston 7805* (G); Sierra de las Cruces, foothills west of Santa Elena Mines, gypsum flats,

1940, *Johnston & Muller 242* (G); Castillon, gypsum flat, 1940, *Johnston & Muller 1271* (G). CHIHUAHUA: 5 mi. south of Jimenez, gypsum flat, 1938, *Johnston 7842* (G); plain below San Carlos, Oct. 1852, *Parry 70* (G).

TEXAS: plains between the Guadalupe Mts. and the Pecos, Oct. 20, 1849, *Wright 348* (G, TYPE; US). NEW MEXICO: San Andreas Mts., ? Dono Ana Co., on gypsum soil, 1914, *Wooton* (US); White Sands, 1904, *Wooton 2545* (US).

This species, constituting the monotypic genus *Dicranocarpus*, gives every evidence of being a pronounced gypsophile. Most of the specimens cited above are definitely known to have been collected on gypsum and most of the remaining few are from localities where gypsum deposits are known to occur. Curiously, the plant at Cedros (where numerous gypsophiles have been collected) and at Mapimi, is noted by the collectors as becoming a weed in cultivated fields.

Thelesperma scabridulum Blake, Jour. Wash. Acad. **25**: 317 (1935).

COAHUILA: endemic on a gypsum flat 6 mi. north of La Ventura, *Lundell 5728* (US, TYPE) and *Johnston 7646* (G).

This well marked species is known only from one locality. It is there confined to a gypsum flat.

Thelesperma ramosius Blake, Proc. Biol. Soc. Washington **54**: 20 (1941).

COAHUILA: one mile south of Hermanas, heavy alkaline soil, 1938, *Johnston 7059* (G, TYPE).

This plant occurs with a number of other unusual species localized on heavy soil near Hermanas. As discussed earlier in this paper, the soil at this locality, though originally not recognized as such, is almost certainly gypseous. The plant, I believe, is a gypsophile.

Flaveria anomala Robins., Proc. Am. Acad. Sci. **27**: 178 (1892).

SAN LUIS POTOSÍ: plains about Matehuala, 1904, *Pringle 8801* (G); 35 mi. south of Matehuala, gypsum flats, 1938, *Johnston 7515* (G); 14 mi. south of Matehuala, local, silty valley floor, 1938, *Johnston 7518* (G); north of Matehuala, gypsum plain, 1938, *Johnston 7524* (G); plains at Venegas, 1890, *Pringle 3669* (G, TYPE); near Salado, gypsum plain, 1939, *Shreve 9354* (G). COAHUILA: 6 mi. north of La Ventura, gypsum plain, *Johnston 7647* (G). NUEVO LEON: near Pablillo, floor of cienega, 1940, *Shreve & Tinkham 9754* (G).

This plant abounds on the gypsum flats north and south of Matehuala.

Gypsum almost certainly occurs about Pablillo, for several gypsophiles have been found localized in that area. The present species appears to be a marked gypsophile.

Flaveria oppositifolia (DC.) Rydb., while apparently not always confined to gypseous soils, seems to luxuriate on this substratum and at some localities is actually restricted to it. Further observations on the soil-preference of this species are needed.

Gaillardia multiceps Greene, Bull. Torr. Bot. Cl. **24**: 512 (1897).

COAHUILA: 1 mi. south of Hermanas [ca. 46 mi. south of Sabinas], local on dry heavy alkaline soil, 1938, *Johnston 7062* (G); on the desert 25 mi. southwest of Sabinas [road to Hermanas], 1936, *Wynd & Muller 209* (NY, US).

TEXAS: Ables, Hudspeth Co., 1927, *Cory 2756* (G). NEW MEXICO: dry plains east of Carlsbad, Eddy Co., 1924, *Standley 40293* (US). ARIZONA: south of Woodruff, Navajo Co., 1892, *Wooton* (TYPE, US); Holbrook, Navajo Co., 1901, *Ward* (NY, US); Holbrook, 1896, *Zuck* (Mo); Camp No. 6, Little Colorado River [ca. 15 mi. w. of Holbrook], 1852, *Sitgreave Exped.* (G); between Winslow and Flagstaff, Coconino Co., 1934, *McKelvey 4535* (G).

Through the kindness of Prof. Marion Ownbey, of the State College of Washington, I am able to cite above the specimens which his student, Miss Susann Fry who is monographing *Gaillardia*, has provisionally referred to *G. multiceps*. Prof. Ownbey writes me that the two Mexican collections closely resemble one another, but differ markedly in habit and general appearance from all the other collections cited.

Near Hermanas the plant is associated with a number of gypsophilous species. Earlier in this paper I have discussed the reasons for believing that the soil was gypseous at this locality. I have no information as to the soil 20 miles further north in Coahuila, where Wynd & Muller also collected the same form. It is interesting to note, however, that Cory collected the species at Ables, in northeastern Hudspeth County, Texas, where he has obtained various markedly gypsophilous species, and that Standley has obtained the only known New Mexican collection of the species west of the Pecos and north of the Texan boundary in a region where extensive gypsum deposits are known. In New Mexico, Texas and Coahuila the species behaves suspiciously like a gypsophile. Should this plant prove to be a gypsophile, its distribution would appear unique. I know of no gypsophilous plant which ranges in eastern New Mexico, western Texas and adjacent Mexico, and also occurs in northern Arizona.

Sartwellia mexicana Gray, Proc. Am. Acad. Sci. **19:** 34 (1883).

COAHUILA: Monclova, *Palmer 687* (G, TYPE; US); 1 mi. south of Hermanas, dry heavy alkaline soil, 1938, *Johnston 7058* (G); San Lorenzo de la Laguna, 1880, *Palmer 683* (G, US); 4 mi. north of Parras, silty soil in bottom of valley, 1938, *Johnston 7705* (G); road to Mohovano, 16 mi. south of Laguna del Rey, gypsum plain, 1938, *Johnston 7818* (G); Carro de Cypriano [near Mohovano], 1901, *Purpus 4476* (G, US). CHIHUAHUA: 5 mi. south of Jimenez, gypsum flat, 1938, *Johnston 7844* (G); between Chapo and Mula, gypseous soil, 1940, *Johnston & Muller 1438* (G).

I believe that this species is restricted to gypsum or mixed gypseous soils. The plant grows on mixed gypseous soil north of La Mula. The soils in which I found it near Hermanas and Parras are probably similar. Gypsum is common in the Laguna del Rey – Mohovano area in which Purpus collected the plant. Various gypsophiles have been collected near San Lorenzo where Palmer found the plant.

Sartwellia puberula Rydb. N. Am. Fl. **34:** 141 (1915).

COAHUILA: Castillon, gypsum flat, 1940, *Johnston & Muller 1267* (G).

At Castillon this plant abounded on a gypsum flat and was obviously confined to it. It agrees with the original description of *S. puberula* Rydb., collected by Parry on "the plains below San Carlos" (where he collected *Dicranocarpus*), south of the Rio Grande in northeastern Chihuahua where gypsum deposits have been reported. The species may be no more than a puberulent variety of *S. mexicana* Gray.

Sartwellia humilis, sp. nov.

Planta perennis humilis; caulibus numerosis decumbentibus vel laxe ascendentibus 5–15 cm. longis simplicibus vel ascendenter ramosis, internodiis 8–15 mm. longis; foliis linearibus glabris quam internodiis 1–2-plo longioribus 10–45 mm. longis 0.5–1 mm. latis carnosulis; capitulis campanulatis in corymbos terminales saepe ca. 15 mm. diametro densos aggregatis; tegulis 5 late elliptico-obovatis herbaceis 2 mm. latis ad 3 mm. longis cum nervis 5–9 nigrescentibus ornatis, margine anguste scariosis; receptaculo obcampanulato 4–5 mm. alto 5–6 mm. crasso apice rotundo glabro; corollis ligularibus ad 5, limbo obovato trinervato ad 1.5 mm. longo et ad 1 mm. lato apice emarginato (bidentato); tubo gracillimo ca. 1 mm. longo; corollis tubulosis ca. 20, tubo ad 1.4 mm. longo, faucibus ad 1 mm. longis, lobis 5 ad 0.5 mm. longis triangularibus; stylo lobato ad 7 mm. longo lineari apicem versus latiore, antheris ca. 0.9 mm. longis appendiculis oblongis ad 0.15 mm. longis terminalibus

ornatis; achaeniis nigris 5-costatis paullo curvatis ca. 1.2 mm. longis apice setas 5 et paleas 5 basim versus connatas proferentibus, paleis oblongis 0.5–0.8 mm. longis supra medium latioribus apice rotundis et laceratis, pilis 0.6–0.9 mm. longis barbellatis.

SAN LUIS POTOSÍ: 4 mi. south of Cedral, gypsum plain, 1938, *Johnston 7567* (G, TYPE). ZACATECAS: Hac. de Sierra Hermosa, gypsum bank, 1938, *Johnston 7405* (G); Cedros, calcareous hills, *Lloyd & Kirkwood 145* (G); Cedros, hills, very calcareous soil, 1907, *Lloyd 14* (US). COAHUILA: 6 mi. north of La Ventura, gypsum plain, 1938, *Johnston 7634* (G). LOCALITY UNKNOWN: Vanegas to Saltillo road, alkaline plain, 1934, *Lundell 5719* (US).

This plant is related to *S. mexicana* but differs in having numerous very short spreading stems and slightly larger heads. A low spreading compact plant, it differs greatly in appearance from the erect, loose, long-stemmed northern *S. mexicana*. I know this species only from gypsum soil. Lloyd reports his collection from "very calcareous soil" and Lundell gives his as from an "alkaline plain." Since botanists frequently allude to gypseous soils in such terms, I am confident they also collected the plant on gypsum. I believe this plant is gypsophilous.

Sartwellia Flaveriae Gray, Pl. Wright. **1**: 122. *t. 6* (1852).

NEW MEXICO: Roswell, Chaves Co., 1900, *Earle 340* (G, US); White Mts., Lincoln Co., 1897, *Wooton 383* (G, US); hills south of road from Rentfrow Ranch to "upper crossing of malpais," Socorro Co., 1923, *Eggleston 19432* (US); White Sands, Otero Co., 1904, *Wooton 2619* (G); 7½ mi. east of Carlsbad, Eddy Co., 1935, *Cory 17615* (G); Pecos Valley near Texas line, Eddy Co., 1901, *Bailey 743* (US). TEXAS: vicinity of Pecos City, Reeves Co., 1913, *Rose & Fitch 17905* (US); Dale, *Havard 92* (US); Screw Bean, 1889, *Nealley 691* (US); Pecos County, 1933, *Cory* (G); common on the Rio Pecos, *Havard 95* (G); western Texas, 1849, *Wright 386* (G, US).

The genus *Sartwellia* consists of three Mexican species, all of which appear to be gypsophilous, and this, the original and most distinct member of the genus, is known only from Texas and New Mexico. It has been collected on gypsum, and its presence in southeastern New Mexico, where gypsum deposits are widely distributed, and in the Pecos Valley of Texas where gypsum also occurs, suggest that *S. Flaveriae* may favor gypseous soils if not actually confined to that substratum. All the species of *Sartwellia*, therefore, give evidences of gypsophily.

Haploesthes Greggii Gray, Mem. Amer. Acad. Sci. n.s. **4**: 109 (1849).

COAHUILA: near Cienega Grande, northeast of Parras, May 18, 1847,

Gregg 68 (G, TYPE); Sierra de la Paila, 8000–9000 ft., 1910, *Purpus 4708* (G, US); south base of Picacho de San José, eastern foothills of Sierra de las Cruces, confined to gypsum exposures, frequent, shrubby, 6–24 in. tall, 1940, *Johnston & Muller 813* (G); eastern foothills of Sierra de las Cruces, near Santa Elena Mines, confined to gypsum flats, frequent, 6–24 in. tall, 1940, *Johnston & Muller 244* (G).

In the eastern foothills of the Sierra de las Cruces, near Santa Elena Mines, and near the base of the Picacho de San José, this plant is locally frequent on exposures of gypsum and confined to them. The plant was so definitely confined to gypseous soils at these localities that I strongly suspect that the other localities at which it has been found have gypseous soils also.

This typical form of the species was first collected by Gregg northeast of Parras at what is now called "Cienega Grande." It is a slender, small, shrubby plant becoming 2 feet tall. Its heads are elongate and similar in form to those of the var. *texana*, but they do not become dusky or blackish green in drying as in the northern variety. Its ligulate flowers are also larger, being usually 3.5–4.5 mm. long and 2–3 mm. wide, rather than 2.5–3.5 mm. long and 1–2.5 mm. wide as in the Texan plant. The elongate tegules of typical *H. Greggii* and its var. *texana* are coriaceous and usually become rugulose in drying.

The recently described *H. robusta* Johnston, Jour. Arnold Arb. **22**: 121 (1941), from the salt-flats near Cuatro Cienegas, is most closely related to the typical form of *H. Greggii*, having the elongate heads and the coriaceous rugulose elongate tegules which do not become dusky in drying. It is, however, a very much more robust plant, coarser in all its parts and not at all shrubby. Gypseous soils are suspected near Cuatro Cienegas and, accordingly, there is a possibility that *H. robusta* may be gypsophilous.

Haploesthes Greggii var. **texana** (Coulter), comb. nov.

Aplopappus texanus Coulter, Contr. U. S. Nat. Herb. **1**: 40 (1890).

CHIHUAHUA: Presidio del Norte [Ojinaga], July 1852, *Parry 68* (G).

TEXAS: Chisos Mts., Brewster Co., 1889, Nealley 203 (US, TYPE); near Lajitas, Brewster Co., infrequent, 1–2 ft. tall, yellow, 1937, *Warnock 727* (US); Presidio Rio Grande [Eagle Pass], Sept.–Oct. 1848, succulent, indicating salt, *Wright 404* (G, US); 10 miles east of Rankin, Upton, 1936, *Cory 15392* (G); Odessa tank, Staked Plains, Ectos Co., 1881, *Havard 96* (G, US); Sweetwater, Nolan Co., 1913, *Wooton* (US); 8 mi. west of Claremont, Kent Co., 1935, *Cory 13846*

(G); O'Donnell, Lynn Co., 1931, *Reed 3436* (US); Estelline, Hall Co., rocky soil, *Reverchon 3991* (G, US); Gambeles Ranch, Armstrong Co., gypseous bank of canyon, 1918, *Palmer 13997* (US); Breckenridge, Stephens Co., open plains, 1925, *Ruth 1271* (US). NEW MEXICO: Round Mt., along Tularosa Creek, Otero Co., July 20, 1905, *Wooton* (US). OKLAHOMA: Hollis, Harmon Co., grassy valley, 1913, *Stevens 1076* (G, US); Antelope Hills, gypsum hills, Roger Mills Co., 1853, *Bigelow* (G); Shattuck, Ellis Co., moist grassy place, 1914, *Clifton 3200* (G).

This northern plant differs from typical *H. Greggii* in its heads, which average smaller and are characteristically dusky or dusky-green when dry. Its ligules average much smaller.

Several of the above cited collections are stated to have been collected on gypsum and most of them are from areas in which large gypsum-deposits and gypseous soils are known. The plant is probably a gypsophile.

Haploesthes Greggii var. **multiflora**, var. nov.

Planta a varietate genuina differt capitulis hemisphaericis multifloris latioribus quam latis, tegulis laevioribus suborbiculatis; ligulis florum marginalium ad 5 mm. longis et 2.5–3 mm. latis.

COAHUILA: Saltillo, common on bottom-lands in good soil, very woody plant with bright yellow flowers, found only in its prescribed area, 1898, *Palmer 206* (G, TYPE); mountains east of Saltillo, 1880, *Palmer 649* (G, US). NUEVO LEON: Monterey, 1924, *Orcutt 1278* (US); open pine-forest [5 mi. NW of Pablillo] 14 mi. south of Galeana, 1940, *Shreve & Tinkham 9755* (G).

This eastern variety of *H. Greggii* is readily recognized by its broad hemispherical heads which contain nearly twice as many florets as do those of other forms of the species. Its ligules become larger than those in the typical form.

I have no information as to whether or not this plant is gypsophilous. It is to be noted, however, that Shreve & Tinkham obtained the plant near Pablillo, in the area in which such gypsophiles as *Muhlenbergia villiflora, Dalea filiciformis* and *Flaveria anomala* have been collected. Furthermore, the note by Palmer, "found only in its prescribed area" is most suggestive of the restricted occurrence of most gypsophilous plants.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY,

THE COMPARATIVE MORPHOLOGY OF THE ICACINACEAE
II. VESSELS

I. W. Bailey and R. A. Howard

With six plates

INTRODUCTION

In anatomically primitive xylem of dicotyledons and monocotyledons, the vessel members resemble scalariform-pitted tracheids in size, form and structure, but differ from them in dissolving certain of their pit membranes during the later stages of tissue differentiation. In the secondary body of less specialized dicotyledons, the fusiform initials of the cambium and the scalariform vessel members are relatively long and have extensively overlapping ends. Furthermore, the vessels tend to be isolated from one another and to be more or less uniformly distributed throughout the wood.

The most significant lines of specialization in the vessels of dicotyledons involve (1) conspicuous changes in the size and form of the vessel members, (2) structural modifications of the scalariform pits and the scalariform perforations and (3) a not uncommon tendency for the vessels to aggregate in multiples, chains or clusters. During the first of these major trends of specialization, the vessel members shorten and frequently increase in diameter. As the vessel members shorten and widen, their perforated facets become less and less acutely, and ultimately transversely, oriented. In other words, with increasing specialization of the vessels, their constituent cells become less and less tracheidlike in size and form, Bailey and Tupper (2) and Frost (4 and 5). These changes in the vessels are closely synchronized with concomitant modifications of the cambium, the fusiform initials becoming shorter and elongating less after anticlinal divisions, Bailey (1). In addition, the salient trends of specialization in the size and form of the vessel members frequently are more or less closely paralleled by structural modifications of the perforations and of the pitting of the vessels. The numerous scalariform perforations of the less specialized types of vessels are ultimately replaced by a single, large, elliptical or circular perforation, and the scalariform pits of the non-perforated parts of the vessel members are superseded by smaller pits having first an opposite and subsequently an alternating arrangement, Bailey and Tupper (2), Frost (6).

THE STRUCTURE OF THE VESSELS IN THREE MAJOR CATEGORIES OF THE ICACINOIDEAE

These salient trends of specialization are well exemplified in the vessels of the Icacinaceae and serve to differentiate the Icacinoideae into various levels of increasing structural modifications. For purposes of the following discussion, it is advisable to segregate the Icacinoideae into three major categories:

I. VESSELS OF BOTH PRIMARY AND SECONDARY XYLEM WITH SCALARIFORM PERFORATIONS

Trilacunar Icacineae

Anisomallon	Cassinopsis	Ottoschulzia
Apodytes	Dendrobangia	Pennantia
Calatola	Emmotum	Pittosporopsis
Citronella*	Oecopetalum	Platea
		Poraqueiba

II. VESSELS OF THE SECONDARY XYLEM WITH SCALARIFORM — POROUS PERFORATIONS

Trilacunar Icacineae

Cantleya	Grisollea	Stemonurus
Discophora	Lasianthera	Urandra
Gastrolepis	Leptaulus	
Gonocaryum	Medusanthera	

III. VESSELS OF THE SECONDARY XYLEM WITH SIMPLE POROUS PERFORATIONS

A. *Unilacunar Icacineae*

Alsodeiopsis	Lavigeria	Merrilliodendron
Desmostachys	Leretia	Pleurisanthes
Humirianthera	Nothapodytes	Rhaphiostylis
Icacina	Mappia	Rhyticaryum

B. *Iodeae* (*Unilacunar*)

Hosiea	Mappianthus	Polyporandra
Iodes	Natsiatum	

C. *Sarcostigmateae* (*Unilacunar*)

Sarcostigma

D. *Phytocreneae* (*Unilacunar*)

Chlamydocarya	Phytocrene	Pyrenacantha
Miquelia	Polycephalium	

In the first of these three categories of the Icacinoideae, the vessels of both the primary and the secondary body are provided with scalariform perforations. The vessel members of the secondary xylem are in general

*In dealing with the genera of the Icacineae we are following the terminology proposed by Howard (7).

very long with more or less extensively overlapping ends, *Figs. 28–31.* The perforated facets of the vessel members tend to be set at a relatively acute angle to the long axis of the vessels. Furthermore, the pitting of the non-perforated facets — except that between vessels and tracheids — is transitional between scalariform and circular-opposite, *Figs. 11–13 and 20–24.*

On the contrary, in the third category of the Icacinoideae, the vessels of the secondary xylem have simple porous perforations, and not infrequently the vessels of the metaxylem are likewise devoid of scalariform perforations. The vessel members are comparatively short and their perforated facets are set either at right angles or at relatively large angles to the long axis of the vessels, *Figs. 47–50.* The non-perforate pits between vessels and between vessels and parenchymatous cells are of the circular-alternating type, *Figs. 17–19.* The walls of the vessels are relatively thick and fused pit apertures are of common occurrence.

The vessel members of the second category, *Figs. 32–45,* of the Icacinoideae are transitional in size, form and structure between the morphologically primitive vessel members of the first category and the highly specialized ones of the third category. Both scalariform and simple-porous perforations occur not only in different vessels of the secondary xylem and in different parts of the same vessel, but also not infrequently at opposite ends of the same vessel element, *Fig. 32.* However, the ratio of scalariform to porous perforations fluctuates greatly in different genera and species and at times in different parts of the same stem.

TABLE I

Length of Vessel Members in Microns

Categories of Icacinoideae	Highest average	Mean of all averages	Lowest average
I. scalariform	2150	1470	950
II. scalariform — porous	1500	1050	700
III. A. porous	750	590	450
III. B–D. porous	600	470	300

As indicated in Table I, the vessel members of Group II are of transitional lengths; the longest-celled species of this group having lengths comparable to the mean of all species in Group I, and the shortest-celled species having averages comparable to the maxima of Group III. The vessel members likewise are of transitional form; those of certain species having perforated facets that are acutely oriented as in Group I and other species having facets that are set at larger angles to the long

axis of the vessels. The pits of the non-perforated facets of the vessels exhibit a wide range of variability, being at times transitional between scalariform and circular-opposite and between circular-opposite and circular-alternate, *Figs. 14–16 and 25–27.*

The vessels in the secondary xylem of most representatives of Group I are numerous, isolated from one another, and more or less uniformly distributed throughout the wood, *Figs. 1–3.*[1] True contacts between different vessels are of infrequent or sporadic occurrence except in certain species of *Pittosporopsis* and *Platea.* In Group III, on the contrary, aggregated vessels or "pore multiples" are of common occurrence, *Figs. 8–10.* As might be anticipated, the distribution of vessels in Group II is transitional and variable; certain species of *Cantleya, Fig. 4, Stemonurus, Fig. 6, Lasianthera, Leptaulus* and *Gonocaryum* exhibiting relatively few contacts between vessels, whereas species of *Discophora, Grisollea, Gastrolepis, Medusanthera* and *Urandra, Fig. 7,* tend to form more or less numerous tangentially, radially or irregularly oriented pore multiples.

Such facts as these demonstrate that there are salient trends of phylogenetic specialization in the vessels of the Icacinaceae which closely parallel those that occur in other families and in the dicotyledons as a whole. Although we have utilized but one of these trends, viz., in the perforations, for differentiating three major categories of the Icacinoideae, such an apparently arbitrary procedure serves to segregate this sub-family into three general levels of increasing structural specialization. That it does so is obviously due to the fact that the various phylogenetic changes in vessels tend in general to be more or less closely correlated.

It should be noted in this connection, however, that the various lines of evolutionary modification are by no means perfectly synchronized. One or more of them may be accelerated when others are retarded or *vice versa.* Furthermore, there are various localized modifications that are divergent from the main trends of phylogeny in vessels. The task of sub-dividing the three major categories of the Icacinoideae into minor levels of structural specialization is complicated by such factors as these. It should be recognized, in addition, that in dealing with minor sub-divisions of a family, where the quantitative and qualitative differences are slight, more attention must be devoted than heretofore to a careful study of the limits of variability within species and in different

[1]An appearance of paired vessels in these transverse sections of the wood is due to the fact that certain of the vessels are cut at a level where the ends of the vessel members overlap.

parts of the same plant, Bailey and Faull (3). In the case of tracheary cells, fairly reliable clues regarding the probable limits of structural variability may be secured by comparing the first-formed secondary xylem, obtained from herbarium specimens, with wood cut from mature stems. The vessel members increase more or less in length and in diameter, *Figs. 4–5,* in passing from the first-formed to the later-formed secondary xylem, and the more conspicuous fluctuations in the form of the vessel members and in the character of their perforations and pits are commonly associated with such variations in size.

DETAILS OF STRUCTURAL SPECIALIZATION WITHIN THE THREE MAJOR CATEGORIES OF THE ICACINOIDEAE

Group I

The most primitive vessel members of the Icacinoideae occur in the metaxylem and first-formed secondary xylem of *Platea.* The long, slender, extensively overlapping vessel members of such species as *P. excelsa* Bl., *P. latifolia* Bl., *P. parviflora* K. & V. and *P. philippinensis* Merr. have a strikingly tracheidlike form, *Fig. 28.* In tangential view, they have very acutely beveled facets, whereas in radial view they have parallel sides and relatively blunt ends. The numerous scalariform perforations either are distributed throughout the overlapping radial facets of the contiguous vessel members or grade into scalariform pits which they closely resemble in size and form. They are actually membraneless scalariform pits with more or less reduced borders. Where the bordering areas of the secondary wall are much reduced, the pit apertures are large and their outlines nearly coincide with those of the perforations in the primary walls. The intervening "bars" between the pit apertures are slender. On the contrary, where the borders are fully developed the pit apertures are narrower and the intervening bars are wider. The pitting between adjacent vessels is dominantly scalariform, *Figs. 11 and 12,* with occasional transitions to opposite, whereas that between the vessels and the parenchymatous cells fluctuates between scalariform, *Fig. 20,* and opposite.

The smallest vessels of the first-formed secondary xylem of *Platea* are but slightly wider than the largest tracheids, and the larger vessels rarely exceed 50 μ in diameter, whereas those of the later-formed wood may at times attain tangential diameters of from 90–140μ and radial dimensions of from 130–210μ. These larger vessel members tend in general to retain a tracheidlike form. *Fig. 29,* in spite of their excessive lateral expansion during tissue differentiation, but some of them become

more or less spindle-shaped in radial view. The perforated facets tend to be less acutely oriented and the scalariform perforations become much extended transversely, viz. at right angles to the long axis of the vessel members. The non-perforate intervascular pits may also attain comparable dimensions, but usually are less extended or are replaced by two or more series of shorter scalariform or oblong pits, *Fig. 12*. The pitting between vessels and parenchymatous cells fluctuates between scalariform and opposite much as it does in the first-formed secondary xylem.

The most highly modified and least tracheidlike vessel members of the Group I Icacinoideae occur in the later-formed secondary xylem of *Emmotum, Fig. 31*. Those of *E. holosericeum* Ducke are relatively long, but the ratio of extensively overlapping cells is lower than in the case of comparable material of *Platea*. The vertically as well as transversely enlarged perforations and the broad intervening bars are reduced in number and are localized in a facet that tends to be oriented at relatively large angles to the long axis of the vessel. Where the vessel members overlap more extensively, their ends expand much less during tissue differentiation than do the intervening parts, and therefore extend beyond the broadly elliptical perforated facets as slender projections of varying lengths. The bordered pits in the non-perforate facets which adjoin those of the other vessel members or of parenchymatous cells are circular or elliptical and tend to be arranged in opposite seriation. Typical scalariform pitting is of sporadic or infrequent occurrence.

The narrower vessel members of the first-formed secondary xylem have more acutely oriented perforate facets and less abruptly tapered ends. Although the perforations are smaller and not infrequently more numerous than they are in the larger vessels of the older wood, they are sharply differentiated in size and form from the non-perforate pits. In certain cases, there appears to be a somewhat higher ratio of scalariform and transitional pitting, particularly in vessels in close proximity to the primary body.

The vessel members of the older wood of *Ottoschulzia cubensis* (Wright) Urb. are much smaller than those in comparable material of *Emmotum holosericeum* Ducke, and more nearly resemble those in the earlier-formed secondary xylem of that species. The perforations and broad intervening bars are reduced in number and are localized in a more or less inclined facet that subtends the slender tips of the vessel members. The enlarged perforations are in marked contrast to the small circular or elliptical pits in the non-perforate facets of the vessels.

The remaining representatives of the Group I Icacinoideae exhibit

various transitional stages of phylogenetic modification and various combinations of morphological specialization. The smaller vessel members of *Oecopetalum mexicanum* Greenm. & Thomps., and of *O. guatemalense* Howard, particularly those of the metaxylem and first-formed secondary xylem, have a primitive tracheidlike form and structure comparable to the conditions in *Platea*. The vessel members of the older wood differ, however, from those of comparable material of *Platea* in having a higher ratio of conspicuously tapered ends, i. e. in radial view. Furthermore, the perforations are less numerous and, in the case of the more extensively overlapping vessel members, are localized in a restricted part of the long acutely oriented radial facets. Structural transitions between perforations and scalariform pits are by no means of infrequent occurrence, but scalariform intervascular pitting is less conspicuously developed than in *Platea*. The vessel-parenchyma pits are dominantly scalariform and transitional, and have much enlarged apertures and reduced borders. Thus, they resemble the scalariform perforations in general size and form.

Somewhat similar vessel-parenchyma pitting, *Fig. 21*, occurs in *Poraqueiba sericea* Tul. and serves to differentiate this plant from *Ottoschulzia cubensis* (Wright) Urb. which was formerly included in *Poraqueiba*. It should be emphasized in this connection that the larger vessel members of *Poraqueiba* resemble those of *Ottoschulzia* and of *Emmotum* in having enlarged perforations, but they have broader and less abruptly tapered ends and the perforated facets are more acutely oriented.

The vessel members of the later-formed secondary xylem of *Pennantia* and of certain species of *Apodytes*, e. g. *A. dimidiata* E. Mey., have attained a form which is comparable to that encountered in *Ottoschulzia*. The perforations are localized in broadly elliptical facets, beyond which the more or less abruptly tapered ends of the cells project for varying distances, *Fig. 30*. However, the perforations differ from those of *Emmotum* and *Ottoschulzia* in having vertical dimensions that are not conspicuously greater than the diameters of the small circular bordered pits, and in being separated by slender intervening bars. In these plants scalariform pitting is likewise of somewhat infrequent or sporadic occurrence and has been replaced by numerous small circular or elliptical pits in opposite seriation.

The vessels of *Anisomallon clusiaefolium* Baill. and of *Calatola costaricensis* Standl. and *C. venezuelana* Pitt. also have narrow perforations and slender bars, but the perforations tend to be more numerous and to be localized in longer facets that are more acutely oriented. Further-

more, the vessel members are of more tracheidlike form in that their overlapping ends taper less markedly and abruptly than in the preceding plants. Although the non-perforate pits of the larger vessels are dominantly of the circular-opposite type, there is a higher ratio of vestigial scalariform and transitional pitting, *Fig. 22.* In our material of *Calatola costaricensis* Standl. and *C. venezuelana* Pitt., as also in that of *Dendrobangia boliviana* Rusby there is an unusually high ratio of abnormal reticulate perforations, *Fig. 23.* In such abnormal perforated facets, the smaller oblong or elliptical perforations have either transverse or diagonal seriations.

The vessel members of *Citronella* (including *Briquetina, Chariessa, Sarcanthidion* and *Villaresia*) and of *Apodytes* fluctuate considerably in size and form, in the number of perforations, in the width of the intervening bars, in the localization of the perforations in facets of varied orientations, and in the ratio of scalariform to opposite pitting, *Figs. 13 and 24.* In certain of these plants, as also in *Cassinopsis tinifolia* Harv., and *Pittosporopsis Kerrii* Craib., the smallest vessel members of the metaxylem and of the first-formed secondary xylem are of approximately as primitive a tracheidlike form and structure as those that occur in *Platea* and *Oecopetalum.*

GROUP II

There are two distinct types of transitions between scalariform and porous perforations in the Group II Icacinoideae. The perforations of *Leptaulus,* e. g. *L. daphnoides* Benth., *L. grandifolius* Engl., and *L. Zenkeri* Engl., fluctuate between 1–12 at each end of the vessel members, *Figs. 39–41.* Where the perforations are more numerous, they vary in form between scalariform, circular and "ephedroid." It is evident that as the perforations are reduced in number in the broader vessels of the later-formed wood, they become larger and are separated by wider intervening bars. Thus, in the genus *Leptaulus,* the simple porous type of perforation results primarily by reduction in the number, and a concomitant increase in size, of the individual perforations. Although the vessel members are relatively small, having diameters of only 45–75μ, in the old wood of *L. daphnoides,* they do not retain a tracheidlike form, *Fig. 39.* The perforations are localized in inclined facets that subtend the slender, abruptly tapered tips of the vessel members. The small, circular or elliptical, intervascular and vessel-parenchyma pits are loosely and somewhat irregularly distributed. Typical scalariform pitting tends to be restricted largely to the primary body.

In all of the other genera of the Group II Icacinoideae, the simple

porous condition arises from scalariform types by the elimination of the more or less numerous bars between the scalariform perforations; or, to express the matter ontogenetically, by the cells not forming such secondary wall thickenings during tissue differentiation. Many transitional stages in the elimination of the bars occur within the vessels of the same stem, *Figs. 34–36 and 38*. Furthermore, as previously stated, the ratio of scalariform and transitional to porous perforations fluctuates greatly not only within different species but also in different parts of the same plant. In general, the number of scalariform and transitional perforations tends to be somewhat higher in the first-formed than in the later-formed secondary xylem.

The highest ratios of scalariform and transitional perforations occur in the first-formed secondary xylem of various species of *Stemonurus*. The vessel members are relatively long and slender, and tend to have smoothly tapered ends. The perforations are localized in restricted areas of the overlapping ends of the vessel members and thus occur in facets that are acutely oriented, *Fig. 32*. The more or less infrequently occurring simple porous perforations are oblong or narrowly elliptical and correspond in size and form to the outlines of the complexes of scalariform or transitional perforations. As the vessel members increase in diameter in subsequently formed secondary xylem, their ends become more abruptly tapered and their perforations are localized in facets that are less steeply inclined. The simple porous perforations commonly are more numerous than in the first-formed secondary xylem and are oval, broadly elliptical or circular. The intervascular and vessel-parenchyma pitting fluctuates between scalariform, opposite and alternate and the ratios of scalariform and oblong to elliptical and circular pits vary considerably not only in different species but also in different parts of the same stem. Aggregations of vessels or pore multiples are of relatively infrequent or sporadic occurrence in most species of *Stemonurus, Fig. 6*.

On the contrary, the vessels of *Medusanthera* and of *Grisollea Thomassetii* Hemsl. tend to aggregate in small radially, diagonally or tangentially oriented clusters. There is a lower ratio of scalariform and transitional types of perforations in the vessels of these plants, even in those of the first-formed secondary xylem, *Figs. 34–36*. The form of the vessel members and of the simple porous perforations fluctuates between the first-formed and the later-formed secondary xylem much as it does in *Stemonurus*. Even in species which have relatively slender vessels in the later-formed secondary xylem, the vessel members have a high ratio of abruptly tapered ends and perforate facets that are set at relatively large angles to the long axis of the vessels, *Fig. 33*. The inter-

vascular and vessel-parenchyma pits are numerous and relatively small as in *Stemonurus*, but there appears to be a somewhat higher ratio of alternate pitting in *Medusanthera*.

The vessels of *Discophora*, *Gastrolepis*, *Urandra* and *Cantleya* may be differentiated from those of the preceding plants by the large size of their intervascular, *Fig. 14*, and vessel-parenchyma pits, *Fig. 26*. The latter pits vary considerably in size, form and orientation and tend to have more or less enlarged apertures. At times, particularly in the smaller vessels of the first-formed secondary xylem, they are scalariform and resemble the vessel-parenchyma pits that occur in *Oecopetalum* and *Poraqueiba* of the Group I Icacinoideae. The ratio of pits with conspicuously enlarged apertures fluctuates considerably in different species and not infrequently in different parts of the same stem. The intervascular pitting varies between scalariform, opposite and alternate, *Figs. 14 and 15*. The size and form of the vessel members, *Fig. 37*, also fluctuate considerably in different species and in different parts of the same plant, as do the size and form of the simple porous perforations, the ratio of scalariform, *Fig. 38*, to simple perforations, *Fig. 37*, and the number and size of the bars in the scalariform and transitional perforations. The vessels of *Cantleya corniculata* (Becc.) Howard have an isolated distribution, *Fig. 4*, whereas those of *Discophora*, *Urandra*, *Fig. 7*, and *Gastrolepis* tend to be aggregated in more or less conspicuous radially, diagonally or tangentially oriented clusters.

The vessels in herbarium material of *Lasianthera africana* Beauv. are isolated. The vessel-parenchyma pits are scalariform with enlarged apertures and thus resemble those that occur in the four preceding genera, but the intervascular pits are small and resemble those that occur in *Stemonurus* and *Medusanthera*. The vessels of *Gonocaryum* also have an isolated distribution and numerous small intervascular pits. However, the vessels of this genus differ from those of all of the preceding genera in the much modified and abnormal form of their scalariform perforations, *Figs. 43–45*, which frequently are vertically, diagonally, concentrically or irregularly, rather than transversely, oriented. The small simple porous perforations tend to be broadly elliptical or circular even in the vessels of the earlier-formed secondary xylem and are localized in small more or less inclined facets that subtend the abruptly tapered ends of the vessel members, *Fig. 42*. The intervascular and vessel-parenchyma pitting is transitional between circular-opposite and circular-alternate, *Fig. 27*, and typical scalariform pitting is of sporadic or vestigial occurrence except in close proximity to the metaxylem.

Group III

As shown in Table I, the vessel members of the Icacinoideae tend to shorten with increasing structural specialization of the vessels. That they tend to widen is indicated in Table II.

TABLE II

Diameter of Largest Vessels in Microns

Inner Secondary Xylem	Group I	Group II	Group III
Less than 40μ	50%	50%	9%
40–65μ	50%	50%	28%
More than 65μ	0%	0%	63%
Outer Secondary Xylem			
Less than 100μ	40%	22%	5%
100–125μ	44%	34%	10%
More than 125μ	16%	44%	85%

This tendency is detectable in the outer secondary xylem of the Group II Icacinoideae, but is not statistically demonstrable without additional data in the first-formed secondary xylem. On the contrary, it is clearly exemplified in both the inner and the outer secondary xylem of the Group III Icacinoideae. That the conspicuous enlargement of the vessels in the first-formed secondary xylem of Group III Icacinoideae is commonly associated with the acquisition of a scrambling or vinelike habit of growth is demonstrated in Table III. It occurs not only in the tribes Iodeae, Sarcostigmateae, and Phytocreneae, but also in scandent species of such genera of the unilacunar Icacineae as *Lavigeria, Leretia, Pleurisanthes* and *Rhyticaryum,* and to a lesser extent in certain species of *Humirianthera* and *Rhaphiostylis* which have a scrambling habit of growth. Therefore, in dealing with the Group III Icacinoideae, it is essential to differentiate between trends of specialization in plants of different habits of growth.

TABLE III

Diameter of Largest Vessels in Microns

Group III: Inner Secondary Xylem	Trees - Shrubs	Scrambling Shrubs	Vines - Lianas
Less than 40μ	35%	0%	0%
40–65μ	58%	33%	12%
More than 65μ	7%	67%	88%

In the arborescent and frutescent species of *Alsodeiopsis, Mappia* and *Nothapodytes,* the vessels tend to occur in radial clusters, *Fig. 8,* or at

times in more extensive, loose, radial grouping. The largest vessels of the first-formed secondary xylem fluctuate in diameter from 30–65μ, whereas those of the later-formed secondary xylem attain tangential diameters of from 80–170μ. Vestiges of scalariform perforations and of scalariform or opposite intervascular pitting are confined to the metaxylem. The vessel members, *Fig. 47,* vary considerably in form, those of smaller diameter having more acutely oriented perforate facets and less abruptly tapered ends. The vessels of *Desmostachys Vogelii* Stapf fluctuate similarly in size and in the form of their constituent cells, *Fig. 46,* but differ from those of the preceding genera in tending to occur in tangential, *Fig. 9,* rather than in radial groupings. There is, in addition, a much higher ratio of scalariform perforations in the metaxylem of both *Desmostachys Vogelii* Stapf and *D. Preussii* Engl. The vessels of *Merrilliodendron* are much reduced in number, but are of relatively large size, attaining diameters of from 70–90μ in the first-formed secondary xylem and as much as 250μ in the later-formed wood. The widely spaced vessels occur singly and in occasional tangentially, diagonally or radially oriented clusters. The pitted vessels of both the metaxylem and the secondary xylem have prevailingly porous perforations. The vessel members, particularly of the outer secondary xylem, have a much higher ratio of transversely oriented perforate facets, *Fig. 50.*

The young stems[1] from herbarium specimens of scrambling or vine-like Icacineae are either of normal structure or exhibit more or less conspicuous "anomalous" features. Thus, in our material of *Humirianthera ampla* (Miers) Baehni, *H. rupestris* Ducke, *Icacina Mannii* Oliv., *I. senegalensis* A. Juss., *Rhyticaryum elegans* Schellenb., and *R. onocarpum* Sch. & Lautb., the internodal parts of the stem have a nearly cylindrical form. The vessels of the secondary xylem, although exhibiting a tendency to occur in loosely organized tangential or concentric grouping as in *Desmostachys,* are more or less uniformly distributed around the stem. They attain maximal diameters of from 50–80μ. On the contrary, in comparable material of *Leretia, Pleurisanthes* and *Rhaphiostylis,* the secondary xylem frequently develops precociously upon opposite sides of the stem, i. e., between the orthostiches. The vessels of the secondary xylem, which attain diameters of from 65–120μ, tend to aggregate in the more rapidly growing sides of the stems. These tendencies towards "anomalous" types of growth are much exaggerated in the stems of various species of *Pleurisanthes,* which during subsequent growth assume a form similar to that of *Iodes ovalis* Bl., illustrated in

[1]Unfortunately, material from older stems of many of these plants is not available at present.

Fig. 7 of the preceding paper of this series. The precociously developed, large-vesselled secondary xylem differs, however, from that formed in comparable material of *Iodes ovalis* in having numerous strands of included phloem. In *Lavigeria salutaris* Pierre, the large-vesselled secondary xylem develops on all sides of the internode and is formed by successive cambia. There appears to be a much lower ratio of vestigial scalariform perforations in the metaxylem of *Lavigeria* and *Pleurisanthes* than in that of *Leretia, Rhaphiostylis,* and particularly of *Humirianthera* and *Icacina.*

Enlargement of the vessels in the first-formed secondary xylem, *Fig. 10,* coupled with conspicuous "anomalous" types of structure, occurs characteristically in the Iodeae, Sarcostigmateae, and Phytocreneae and has been adequately illustrated in the first paper of this series. *Mappianthus* and *Sarcostigma* are exceptional in having a normal cylindrical secondary body and vessels that are not aggregated between the orthostiches. *Sarcostigma* is characterized, in addition, by having numerous strands of intraxylary soft bast and vessels that are arranged in loose radial groupings. Furthermore, we have called attention in our preceding paper to the fact that in *Hosiea sinense* (Oliv.) Hemsl. and *Iodes liberica* Stapf, the young stems are extraordinarily variable; certain of them having small vessels that are localized in distribution and others having large vessels that are more or less uniformly arranged around the stem.

In most of the Iodeae, Sarcostigmateae and Phytocreneae, the pitted vessels of the metaxylem have exclusively porous perforations. There commonly is a higher ratio of vessel members with slightly inclined or transversely oriented perforate facets in both the metaxylem and secondary xylem, *Fig. 49,* of these plants than there is in a majority of the unilacunar Icacineae. The most highly specialized vessels of the Icacinoideae occur in various representatives of the Phytocreneae. The larger vessels frequently are composed of very short members which are broader than long, have truncated ends and are devoid of projecting tips, *Fig. 48.* These plants also form curious slender, "fibriform" vessel members in the much modified outer part of the primary body.

DISCUSSION

The data recorded in the preceding pages indicate that there are clearly defined trends of specialization in the vessels of the Icacinoideae. Most of these lines of phylogenetic modification are irreversible and parallel those that occur in other families of the dicotyledons. Thus, it is possible to differentiate the Icacinoideae into various levels of

increasing structural specialization. That such levels of specialization may be of some taxonomic, as well as of purely phylogenetic, interest is suggested not only by the general grouping of genera and tribes within our three major categories of the Icacinoideae, but also by the fact that all of the Icacineae in Group III have unilacunar nodes whereas those in Group I and II have trilacunar ones. It should not be inferred from this, however, that all of the genera in one of these categories are necessarily more closely related genetically to one another than to genera in the other categories. Parallel development and convergent evolution are of such common occurrence in foliar and cauline, as well as in floral, structures that evidence from all parts of the plant must be harmonized and integrated in attempting to determine actual genetic affinities within an order, family, sub-family or tribe. Therefore, a discussion of the taxonomic implications of the data presented in this paper should be deferred until we have completed our investigations of other tissues and organs of the Icacinoideae.

SUMMARY

1. A study of the vessels reveals salient irreversible trends of structural specialization in the Icacinaceae which parallel those that occur in other families of the dicotyledons.

2. These lines of phylogenetic specialization tend in general to be more or less closely correlated and may be utilized in differentiating the Icacinoideae into successive levels of increasing structural modification.

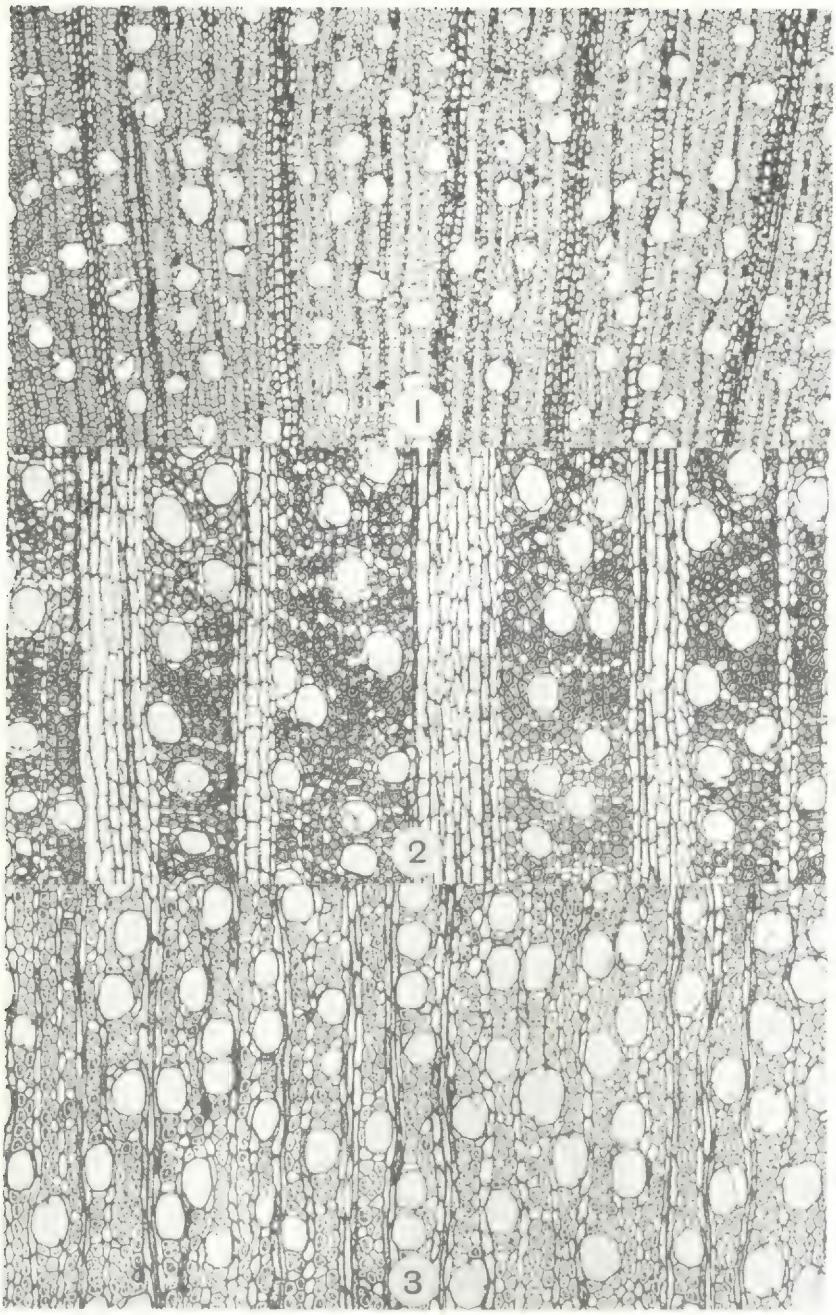
3. For the present, it is not advisable to attempt to subdivide the Icacinoideae upon this basis into more than three major categories: (I) those having vessels with exclusively scalariform perforations, (II) those having scalariform-porous perforations in the vessels of the secondary xylem and (III) those having exclusively porous perforations in the secondary body.

4. It is significant in this connection that the unilacunar Icacineae — which were differentiated in the first paper of this series — occur together with the unilacunar Iodeae, Sarcostigmateae and Phytocreneae in our third category of the Icacinoideae.

LITERATURE CITED

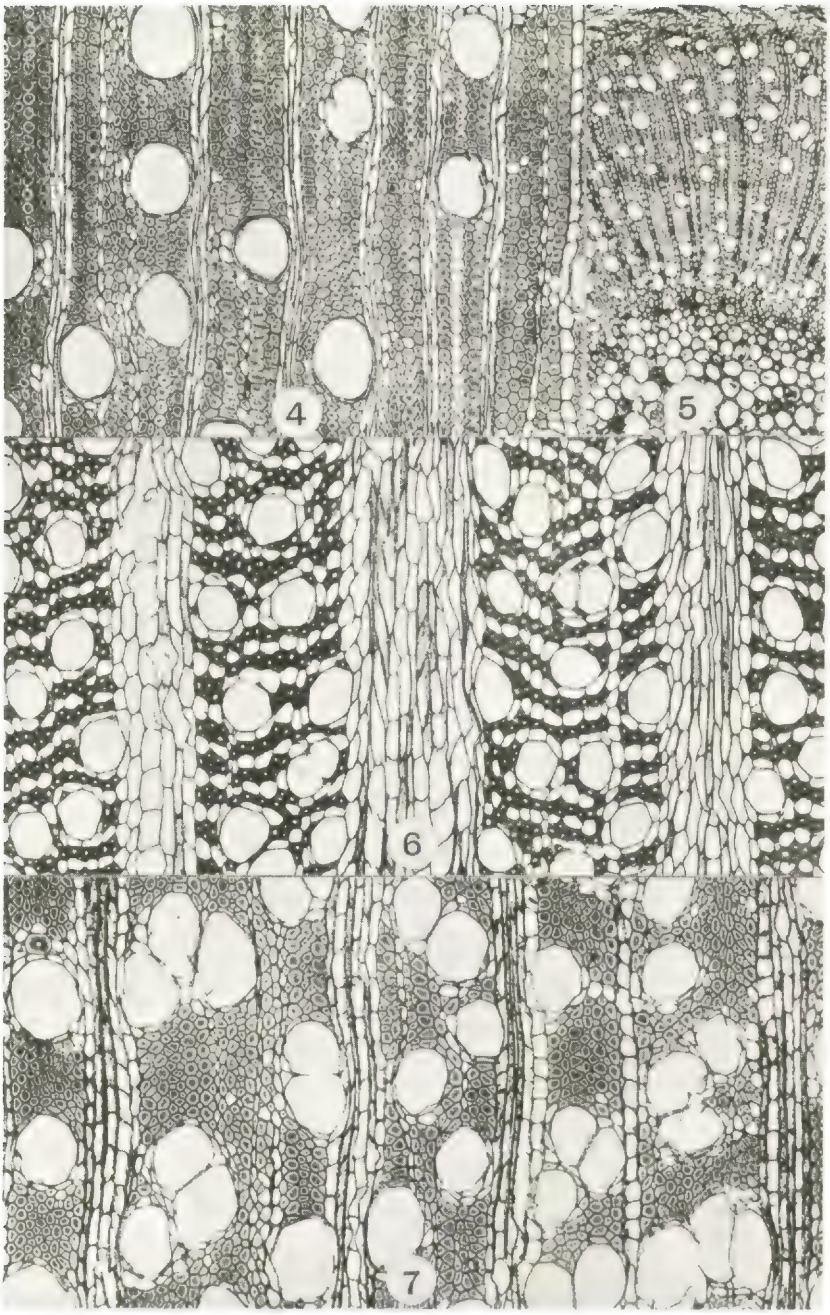
1. BAILEY, I. W. The cambium and its derivative tissues. IV. The increase in girth of the cambium. Amer. Jour. Bot. **10**: 499–509. 1923.

2. BAILEY, I. W. AND W. W. TUPPER. Size variations in tracheary cells. I. A comparison between the secondary xylems of vascular cryptogams, gymnosperms and angiosperms. Proc. Amer. Acad. Arts and Sciences. **54**: 149–204. 1918.



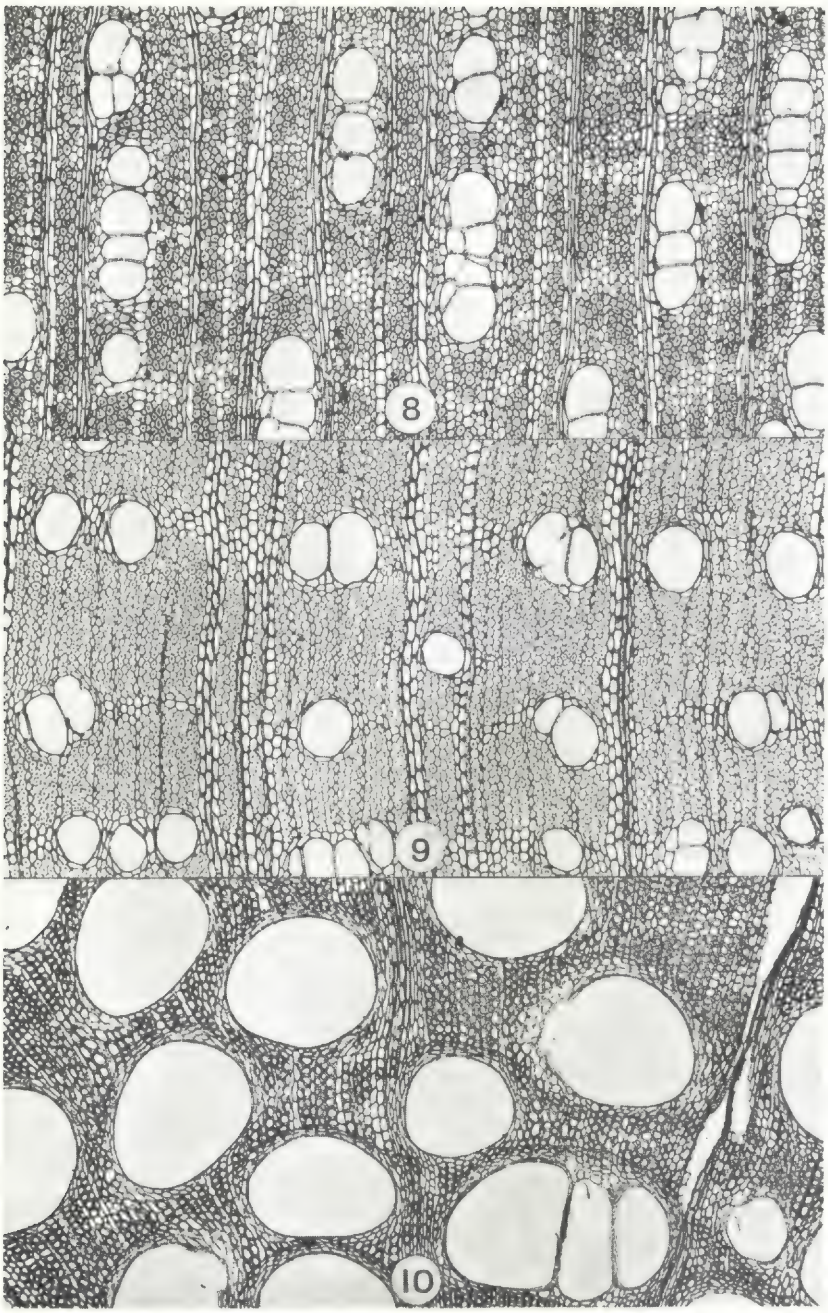
COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE—MERIDEN



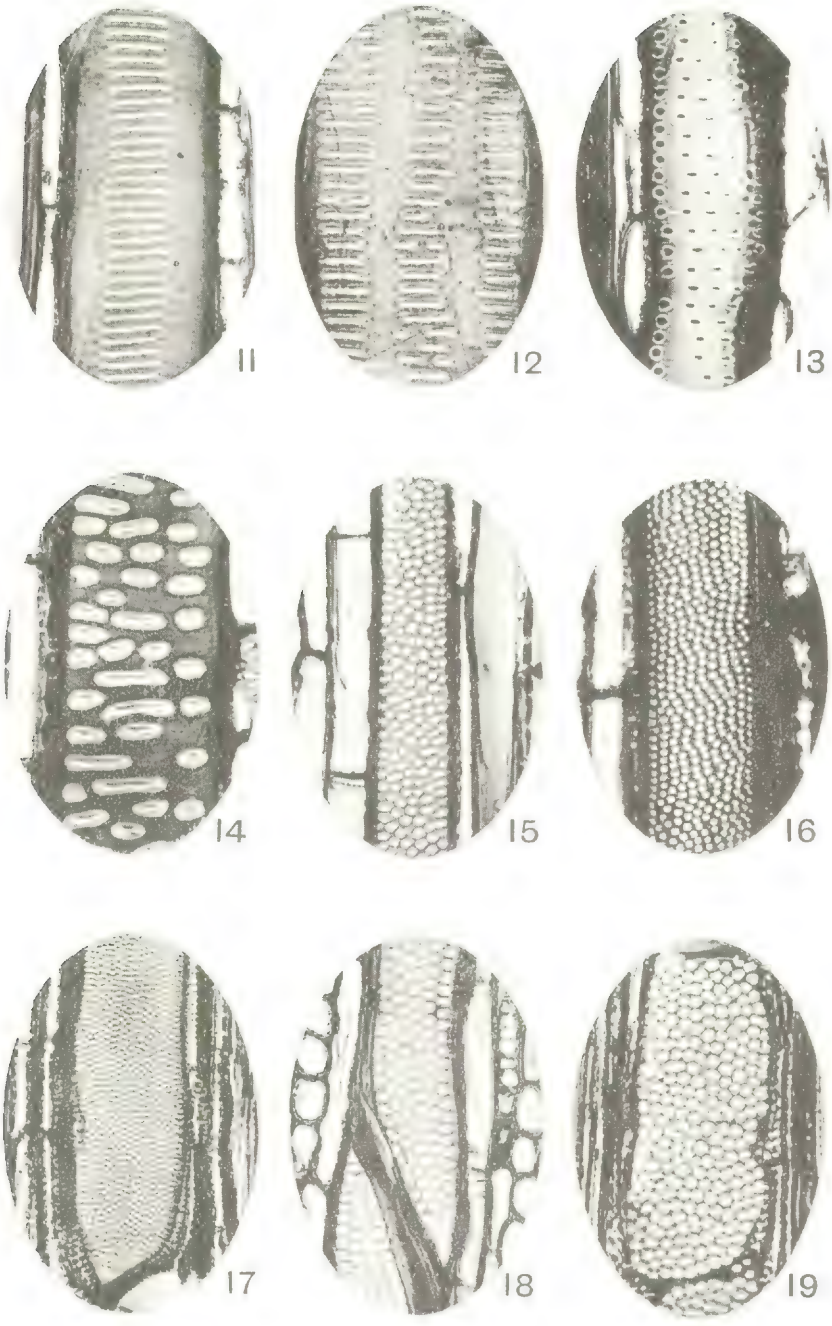
COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE—MERIDEN



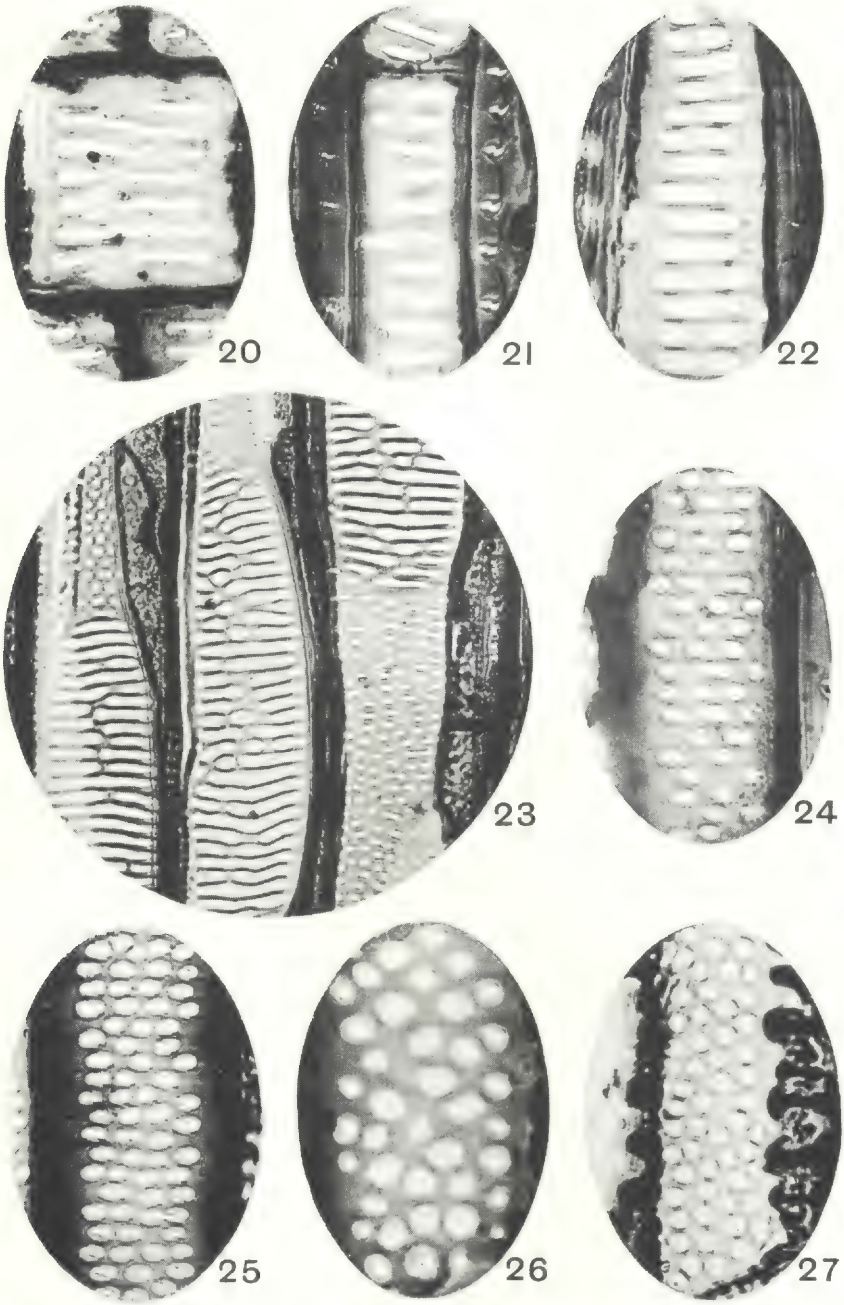
COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE ... HIDEN



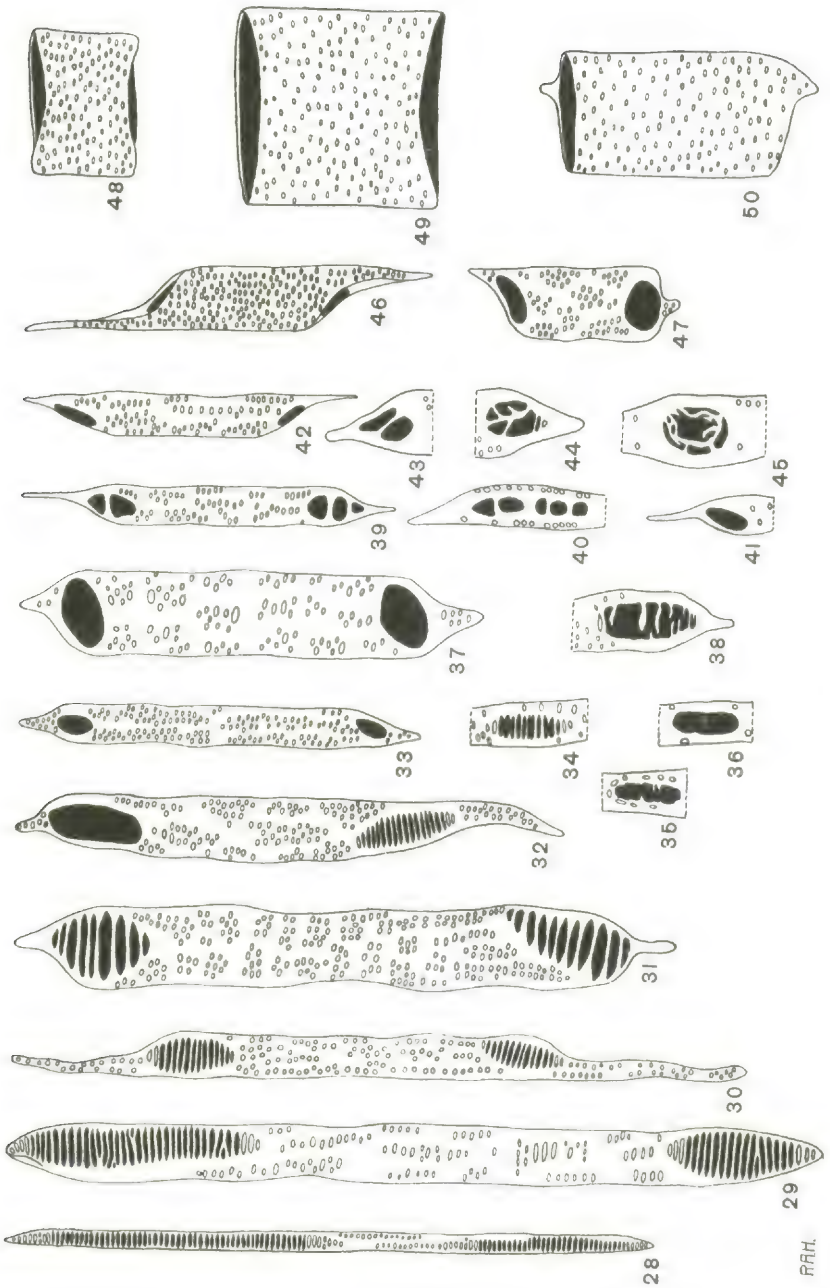
COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE - MER DEN



COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE—MERIDEN


48
49
50
46
47
42
43
44
45
39
40
41
37
38
33
34
36
35
32
31
30
29
28
RAH.

3. Bailey, I. W. and Anna F. Faull. The cambium and its derivative tissues. IX. Structural variability in the redwood, Sequoia sempervirens, and its significance in the identification of fossil woods. Jour. Arnold Arb. **15**: 233–254. 1934.

4. Frost, F. H. Specialization in secondary xylem of dicotyledons. I. Origin of vessel. Bot. Gaz. **89**: 67–94. 1930.

5. ———— II. Evolution of end wall of vessel segment. Bot. Gaz. **90**: 198–212. 1930.

6. ———— III. Specialization of lateral wall of vessel segment. Bot. Gaz. **91**: 88–96. 1931.

7. Howard, R. A. Studies of the Icacinaceae. I. Preliminary taxonomic notes. Jour. Arnold Arb. **21**: 461–489. 1940.

DESCRIPTION OF PLATES

Plate I

Group I

Fig. 1. *Oecopetalum guatemalense* Howard, *Skutch 954.*
Transverse section of the secondary xylem. × 50.

Fig. 2. *Citronella Smythii* (F. v. Muell.) Howard, *Y. U. 20056.*
Transverse section of the secondary xylem. × 50.

Fig. 3. *Apodytes javanica* K. & V., *Y. U. 30521.*
Transverse section of the secondary xylem. × 50.

Plate II

Group II

Fig. 4. *Cantleya corniculata* (Becc.) Howard, *Y. U. 12586.*
Transverse section of the outer secondary xylem. × 50.

Fig. 5. *Cantleya corniculata* (Becc.) Howard, *Kew 2797.*
Transverse section of the inner secondary xylem. × 50.

Fig. 6. *Stemonurus luzoniensis* (Merr.) Howard, *Y. U. 2310.*
Transverse section of the secondary xylem. × 50.

Fig. 7. *Urandra secundiflora* (Blume) O. Ktze., *Y. U. 16041.*
Transverse section of the secondary xylem. × 50.

Plate III

Group III

Fig. 8. *Mappia racemosa* Jacq., *Y. U. 12196.*
Transverse section of the secondary xylem. × 50.

Fig. 9. *Desmostachys Vogelii* Stapf, *Y. U. 15097.*
Transverse section of the secondary xylem. × 50.

Fig. 10. *Iodes ovalis* Bl., *H. U. 2775.*
Transverse section of the secondary xylem. × 50.

Plate IV

Group I

Fig. 11. *Platea species*, *Y. U. 20201.*
Scalariform intervascular pitting. × 230.

FIG. 12. *Platea parviflora* K. & V., *Y. U. 30529.*
Scalariform and opposite intervascular pitting. × 230.

FIG. 13. *Citronella Smythii* (F. v. Muell.) Howard, *Y. U. 20056.*
Widely spaced opposite intervascular pitting. × 230.

Group II

FIG. 14. *Urandra Ammui* Kanehira, *Y. U. 20405.*
Large scalariform and transitional intervascular pits. × 230.

FIG. 15. *Discophora guianensis* Miers, *N. Y. 87444.*
Vessel of first-formed secondary xylem showing opposite and alternate intervascular pitting. × 230.

FIG. 16. *Stemonurus Merrittii* Merr., *H. U. 8215.*
Helically arranged opposite intervascular pitting, transitional to alternate. × 230.

Group III

FIG. 17. *Alsodeiopsis Staudtii* Engl., *Y. U. 24019.*
Alternate intervascular pitting. × 230.

FIG. 18. *Mappia racemosa* Jacq., *Y. U. 12196.*
Alternate intervascular pitting. × 230.

FIG. 19. *Miquelia caudata* King, *N. Y. 4478.*
Alternate intervascular pitting. × 230.

PLATE V

Group I

FIG. 20. *Platea latifolia* Bl., *Y. U. 30522.*
Scalariform vessel-parenchyma pitting. × 450.

FIG. 21. *Poraqueiba sericea* Tul., *Y. U. 17781.*
Scalariform vessel-parenchyma pitting with enlarged apertures. × 450.

FIG. 22. *Anisomallon clusiaefolium* Baill., *Y. U. 14252.*
Scalariform and opposite vessel-parenchyma pitting. × 450.

FIG. 23. *Dendrobangia boliviana* Rusby, *N. Y. 2856.*
Scalariform and reticulate perforations. Scalariform and opposite intervascular pitting. × 230.

FIG. 24. *Citronella Smythii* (F. v. Muell.) Howard, *Y. U. 20056.*
Opposite vessel-parenchyma pitting. × 450.

Group II

FIG. 25. *Stemonurus luzoniensis* (Merr.) Howard, *Y. U. 2310.*
Opposite vessel-parenchyma pitting. × 450.

FIG. 26. *Discophora guianensis* Miers, *Y. U. 34081.*
Large alternate vessel-parenchyma pitting. × 450.

FIG. 27. *Gonocaryum cognatum* Elmer, *H. U. 22242.*
Alternate vessel-parenchyma pitting. × 450.

PLATE VI

Group I

FIG. 28. *Platea excelsa* Bl., *H. U. 2766.*
Vessel from the first-formed secondary xylem. × 55.

FIG. 29. *Platea species*, *Y. U. 20201.*
Vessel from the outer secondary xylem. × 55.

FIG 30. *Apodytes dimidiata* E. Mey., *Y. U. 14933.*
Vessel from the outer secondary xylem. × 55.

FIG. 31. *Emmotum holosericeum* Ducke, *Y. U. 33816.*
Vessel from the outer secondary xylem. × 55.

Group II

FIG. 32. *Stemonurus luzoniensis* (Merr.) Howard, *Y. U. 2310.*
Vessel from the outer secondary xylem. × 55.

FIG. 33. *Medusanthera samoensis* (Rein.) Howard, *H. U. 19471.*
Vessel from the outer secondary xylem. × 55.

FIGS. 34–36. *Medusanthera samoensis* (Rein.) Howard, *A. 3061.*
Three types of perforations in vessels from the first-formed secondary xylem. × 220.

FIG. 37. *Urandra secundiflora* (Bl.) O. Ktze., *Y. U. 16042.*
Vessel from the outer secondary xylem. × 55.

FIG. 38. *Urandra Ammui* Kanehira. *A. 4596.*
Scalariform type of perforations in a vessel from the inner secondary xylem. × 220.

FIG. 39. *Leptaulus daphnoides* Benth., *Y. U. 19758.*
Vessel from the outer secondary xylem. × 55.

FIGS. 40–41. *Leptaulus grandifolius* Engl., *Zenker 14.*
Types of perforations in vessels from the inner secondary xylem. × 220.

FIG. 42. *Gonocaryum melanocarpum* Hochr., *Krukoff 4218.*
Vessel from the outer secondary xylem. × 55.

FIGS. 43–45. *Gonocaryum melanocarpum* Hochr., *Krukoff 4218.* Types of perforations in vessels from the inner secondary xylem. × 220.

Group III

FIG. 46. *Desmostachys Vogelii* Stapf, *Y. U. 15097.*
Vessel from the outer secondary xylem. × 55.

FIG. 47. *Mappia racemosa* Jacq., *Y. U. 12196.*
Vessel from the outer secondary xylem. × 55.

FIG. 48. *Phytocrene macrophylla* Bl., *H. U. 2770.*
Vessel from a small stem. × 55.

FIG. 49. *Iodes ovalis* Bl., *H. U. 2775.*
Vessel from a small stem. × 55.

FIG. 50. *Merrilliodendron rotense* Kanehira, *Y. U. 33233.*
Vessel from the outer secondary xylem. × 55.

BIOLOGICAL LABORATORIES,
HARVARD UNIVERSITY.

STUDIES IN THE THEACEAE, VI
THE GENUS SYMPLOCOCARPON AIRY-SHAW

CLARENCE E. KOBUSKI

IN 1936, Bullock described a new species of *Eurya*[1] from Mexico and gave it the name *Eurya Hintoni* after the collector, G. B. Hinton. The following year Airy-Shaw[2] described a new genus, *Symplococarpon*, based upon *Eurya Hintoni* Bullock and three additional Hinton specimens from Mexico, the type species being *Symplococarpon Hintoni* (Bullock) Airy-Shaw. This outstanding new genus is characterized by an inferior or nearly inferior ovary, fruit resembling that of the genus *Symplocos*, and persistent bracteoles. Its nearest relative in the Theaceae is the genus *Cleyera*, with which it agrees in "the arborescent habit, foliage, fasciculate long-pedicelled flowers, and anther structure." A detailed discussion of its generic status and relationships is so well recorded by Airy-Shaw that it would be superfluous to repeat it in this study. The following generic description contains additional information based on the more abundant material available from the Gray Herbarium, Field Museum of Natural History, Missouri Botanical Garden, New York Botanical Garden and the United States National Museum.

Symplococarpon Airy-Shaw in Hooker's Icon. Pl. **34**: t. 3342. 1937.

Trees with alternate branches. Leaves alternate, entire or serrate. Flowers hermaphroditic, axillary, fasciculate; pedicels minutely bracteate at the base with 2 persistent bracteoles, opposite or nearly so, at or near the juncture of the pedicel and the hypanthium. Sepals 5, imbricate, persistent. Petals 5, alternate with the sepals, imbricate, slightly connate at the base. Stamens 25–40, uniseriate; filaments connate at and adnate to the base of the corolla; anthers oblong-elliptic, tapering at the apex into a distinct subulate mucro. Ovary inferior, 2-celled, extreme apical portion usually exserted slightly above the base of the persistent calyx-lobes, appearing as a disk; ovules solitary in each cell; styles 2, rarely 3, free to the base, arising erect from the center of the seeming disk. Fruit indehiscent, subglobose, crowned by the persistent calyx and styles, two-celled, two-seeded.

[1]Kew Bull. Misc. Inform. **1936**: 391. 1936.
[2]Hooker's Icon. Pl. **34**: t. 3342. 1937.

TYPE SPECIES: *Symplococarpon Hintoni* (Bullock) Airy-Shaw.

KEY TO THE SPECIES

A. Apex of ovary (superior portion) hirsute.
  B. Filaments of the stamens not thickened at the base.
    C. Styles glabrous; leaf-margin entire with only an occasional vestige of denticulation; veins obscure on both surfaces. .....1. *S. Hintoni.*
    CC. Styles hirsute on lower half; leaf-margin sharply serrate; veins very prominent on both surfaces. .....6. *S. Brenesii.*
  BB. Filaments of the stamens noticeably thickened at the base.
    D. Fascicles 3–4-flowered; styles 2–3; leaves obtuse or rounded at the apex; leaf-margin entire or lightly undulate; small tree up to nine meters. .....4. *S. chiriquiense.*
    DD. Fascicles up to 11-flowered; styles 2; leaves acuminate at the apex; leaf-margin serrate; large tree up to 25 meters. .....5. *S. multiflorum.*

AA. Apex of ovary (superior portion) glabrous.
  E. Leaves lanceolate, 5–9 cm. long, 2.0–2.8 cm. wide; calyx-lobes 1.5–2.0 mm. wide; petals 2.0–3.5 mm. wide; mucro of the stamens 0.25–0.50 mm. long. .....2. *S. Airy-Shawianum.*
  EE. Leaves oblong-obovate, 8–15 cm. long, 2.5–5.5 cm. wide; calyx-lobes 3–4 mm. wide; petals 4–6 mm. wide; mucro of stamens 1.50–1.75 mm. long. .....3. *S. Purpusii.*

1. **Symplococarpon Hintoni** (Bullock) Airy-Shaw in Hooker's Icon. Pl. **34:** t. 3342. 1937, pro parte typica.

Eurya Hintoni Bullock in Kew Bull. Misc. Inform. **1936:** 391. 1936.

Small tree (*Hinton 8653*, 10 m.) with rough, glabrous, densely lenticellate branchlets. Leaves glabrous, oblong-elliptic, coriaceous, very smooth but not shining, 4–7 cm. long, ± 2 cm. wide, acute at the apex, cuneate at the base, subentire with an occasional minute denticulation on the upper half of the leaf, the midrib deeply canaliculate; petiole 1–3 mm. long. Flowers axillary, in fascicles of 1–3; pedicel ± 7 mm. long, glabrous, graceful, usually recurved. Bracteoles 2, minute, ± 1 mm. long, subopposite, sepaloid, ciliolate, otherwise glabrous. Hypanthium obconic-obovoid, glabrous, ± 2 mm. long. Calyx-lobes 5, unequal, imbricate, suborbicular, 1–2 mm. long, 1.5–2.0 mm. wide, glabrous except for the ciliolate margin. Petals 5, unequal, imbricate, 3.5–5.0 mm. long, 2.0–3.5 mm. wide, obtuse, the margin incurved. Stamens ± 30, uniseriate; filaments up to 2 mm. long, adnate to the base of the corolla; anthers less than 1 mm. long; mucro subulate, 0.25–0.50 mm.

long. The superior (disk-like) portion of the ovary sparingly hirsute. Styles 2, free, ± 3 mm. long. Fruit unknown.

MEXICO: District of Temascaltepec, State of Mexico, Mina de Agua, in a barranca, *G. B. Hinton 8653* (TYPE, Kew; isotypes, AA, FM, NY), Nov. 13, 1935 (tree 10 m.).

Recently, while engaged on some preliminary work on American Theaceae, I discovered that the species *Ternstroemia Purpusii* Brandegee belongs to *Symplococarpon*. At first, I assumed that it belonged to *S. Hintoni,* but on comparison realized that it was a new species, very distinct from the type. This species will be discussed later. It was during this comparison that I reached the conclusion that Airy-Shaw had included two entities in his *S. Hintoni*. Fortunately, the four Hinton numbers cited by Airy-Shaw are available for my examination. Of these, I find that no. *8653,* the type of *Eurya Hintoni* Bullock (now the type of *Symplococarpon Hintoni*) is distinct from the other three numbers, *2426, 3081* and *3678*. The type, no. *8653,* has narrowly elliptic, coriaceous leaves, 4–7 cm. long and ca. 2 cm. wide, entire or nearly so (slight indication of serration of a few leaves), with a canaliculate midrib. Also, the leaves are smooth and opaque, hardly shining. Because of the coriaceous texture, the veins (8–10 pairs) are quite obscure. The petals of the corolla measure 3.5–5.0 mm. long and 2.0–3.5 mm. wide. The young branchlets are densely lenticellate. The apex of the ovary above the hypanthium and calyx-lobes is sparsely hirsute. The fruit, as described by Airy-Shaw, belongs to the following species.

2. **Symplococarpon Airy-Shawianum,** sp. nov.

Symplococarpon Hintoni Airy-Shaw in Hooker's Icon. Pl. **34**: t. 3342. 1937, pro parte.

Arbor 10-metralis (procerior, fide *Hinton 3678*), ramulis glabris sparse lenticellatis. Folia lanceolata vel sublanceolata, 5–9 cm. longa et 2.0–2.8 (–3) cm. lata, basi cuneata vel rare subrotundata, apice abrupte acuminata, submembranacea, glaberrima, opaca, costa supra complanata, margine leviter serrata, nervis lateralibus ca. 14-jugis gracilibus anastomosantibus, petiolis 2–5 mm. longis. Flores axillares, 1–6 fasciculati, pedicellis basi minute bracteatis, apice infra hypanthium bi-bracteolatis, bracteolis oppositis vel suboppositis persistentibus minutissimis ca. 1 mm. longis sepaloideis ciliatis; hypanthium obconico-obovoideum, ca. 2 mm. longum, basi ca. 1 mm. et apice ca. 2 mm. diametro, glabrum, calycis lobis 5 inaequalibus imbricatis glabris ovatis vel subrotundatis pergamenaceis ca. 2 mm. longis et 1.5–2.0 mm. latis

margine ciliolatis; petala 5, ovata vel obovata, 5–7 mm. longa et 1.5–2.0 mm. lata, margine incurvata; stamina 30–40, uniseriata, filamentis glabris ad 2 mm. longis, basi petalis adnatis, antheris ca. 1 mm. longis, mucrone subulato 0.25–0.50 mm. longo; ovarium toto inferius vel fere, glabrum; styli 2, liberi, 2.5–3.5 mm. longi. Fructus (*Hinton 3678,* immaturus ?) viridis, oblongo-obovatus, ad 13 mm. longus et 7 mm. diametro, lobis calycis et stylis coronatus.

Mexico: District of Temascaltepec, State of Mexico, Manchititla, in barranca, *G. B. Hinton 3081* (type FM; isotypes, NY, US), January 2, 1933 (tree 10 m. high).—Temascaltepec, in barranca, alt. 2080 m., *G. B. Hinton 3678* (AA), March 31, 1933 (large tree; a fruiting specimen of *Hinton 2426.*)

This species is characterized by leaves 5–9 cm. long and 2.0–2.8 (–3) cm. wide, membranaceous, lanceolate-acuminate (the apex more abruptly and longer acuminate than *S. Hintoni*), denticulate, opaque, not shining, midrib (unlike *S. Hintoni*) flat. The veins are more numerous (ca. 14 pairs) and more pronounced on the lower surface than in *S. Hintoni.* The superior portion of the ovary, above the hypanthium, is strictly glabrous while in *S. Hintoni,* it is hirsute.

The fruit, probably immature, is indehiscent, oblong-obovate, up to 13 cm. long and 7 cm. diameter, brownish green, crowned by the persistent calyx-lobes and styles.

3. **Symplococarpon Purpusii** (Brandegee), comb. nov.

Ternstroemia Purpusii Brandegee in Univ. Calif. Publ. Bot. **6**: 187. 1915.

Tree (probably) with glabrous, rather smooth, sparsely lenticellate branchlets. Leaves glabrous, oblong-obovate, membranaceous, shining, 8–15 cm. long, 2.5–5.5 cm. wide, obtusely acuminate at the apex, cuneate at the base, the margin crenulate, the midrib flat, not canaliculate; petiole 2–3 mm. long. Flowers axillary, in fascicles of 1–3; pedicel ± 8 mm. long, glabrous, sturdy, usually erect, ca. 1 mm. diameter at the hypanthium. Bracteoles 2, subopposite, minute, sepaloid, ciliolate. Hypanthium obconic-obovoid, glabrous 2–3 cm. long. Calyx-lobes 5, unequal, imbricate, suborbicular, 2–3 mm. long, 3–4 mm. wide, glabrous except for the ciliolate margin. Petals 5, unequal, imbricate, 5–7 mm. long, 4–6 mm. wide, obtuse, the margin incurved. Stamens ± 30 (25–40), uniseriate; filaments 1.5–2.5 mm. long, adnate to the base of the corolla; anthers up to 2 mm. long; mucro subulate, 1.50–1.75 mm. long. The superior (disk-like) portion of the ovary glabrous. Styles 2, free, 4–5 mm. long. Fruit unknown.

MEXICO: State of Chiapas, Finca Irlanda, *C. A. Purpus 7434* (isotypes of *Ternstroemia Purpusii* AA, G, FM, NY), June 1914.

This species is based upon *Ternstroemia Purpusii* Brandegee collected by C. A. Purpus (no. *7434*) in the State of Chiapas, Mexico. It was the study of this specimen that led to the present brief survey of *Symplococarpon*.

The leaves of this species are considerably larger than those of the other two species mentioned above, 8–15 cm. long and 2.5–5.5 cm. wide, membranaceous, oblong-obovate, obtusely acuminate at the apex with a delicately serrate margin. In the leaf-margin, the flat open midrib, and the glabrous ovary, this species resembles *S. Airy-Shawianum*. The pedicels in all three Mexican species vary not more than 2 mm. in length. However, the first two are characterized by graceful recurved pedicels which measure 0.5 mm. in diameter at the base of the flower. In the plate accompanying the description of the new genus, the flowers appear to be borne on erect pedicels. The flowers in the Hinton collections studied at the Arnold Arboretum are on recurved pedicels. *Symplococarpon Purpusii* is characterized by more sturdy pedicels, varying little from those of the Hinton numbers in length, but at the point of the bracteoles the pedicels measure ± 1 mm. in diameter, as opposed to ± 0.5 mm. of *S. Hintoni* and *S. Airy-Shawianum*. This trifling difference in diameter does cause the flowers in most instances, to stand erect, especially those in the axils of the upper leaves, where they are less crowded. Some of the flowers in the lower axils do curve somewhat but not to the degree shown by those in *S. Hintoni* and *S. Airy-Shawianum*. The mucro of the stamen in this species is three-times longer (1.50–1.75 mm.) than the mucro in any other known species (up to 0.5 mm.).

4. **Symplococarpon chiriquiense,** sp. nov.

Arbor parva, 6–9-metralis (fide collectore), ramulis glabris, non lenticellatis. Folia oblongo-obovata, glabra, coriacea vel subcoriacea, 4–6 cm. longa et 1.8–3.0 cm. lata, supra nitida, subtus pallidiora, apice obtusa vel rotundata, basi cuneata, margine integerrima vel leviter undulata, costa supra complanata, nervis ca. 5–7 paribus utrinque prominentibus, petiolis glabris 2–3 mm. longis. Flores axillares, 3–4-fasciculati; pedicelli glabri, recurvi, 11–12 mm. longi, apice infra hypanthium bracteolis 2 inaequalibus 0.3–1.0 mm. longis oppositis vel suboppositis persistentibus sepaloideis ciliolatis; hypanthium glabrum, obconico-obovoideum, ca. 2 mm. longum, calycis lobis 5 inaequalibus imbricatis pergamenaceis ca. 1 mm.

longis et 1.5 mm. latis, apice obtusis vel flabelliformibus, margine ciliolatis; petala 5, obovata vel subrotundata, imbricata, 6–7 mm. longa et 4–6 mm. lata, margine incurvata; stamina ca. 25, uniseriata, filamentis glabris ad 3 mm. longis, basi subcrassis et petalis adnatis, antheris ca. 0.75 mm. longis, mucrone subulato ca. 0.3 mm. longo; ovarium fere totum inferius ovarii parte superiore dense albo-hirsuta; bi- vel ? triloculare; styli 2 vel 3, liberi, ca. 3 mm. longi, glabri. Fructus ignotus.

PANAMA: Boquete District, Chiriqui Prov., alt. 1500 m., *M. E. Davidson 799* (FM), June 27, 1938 (small tree 20–30 ft. high with cream-colored flowers.)

This species may be characterized by oblong-obovate, entire, glabrous leaves, conspicuously veined on both surfaces. The flowers are axillary and 3–4-fascicled. All parts, except the somewhat flat apex of the ovary, the very young buds and the midrib (lower surface) of the youngest leaves, are glabrous. The filaments are about 3 mm. long. The styles vary in number from two to three. This is the first instance of three styles appearing in the genus and it links *Symplococarpon* even closer to the genus *Cleyera*.

Its nearest relative is *S. multiflorum*, which can be separated from *S. chiriquiense* by the many-flowered fascicles (up to nine) as compared to the few-flowered fascicles of the present species. Also, the number of styles in *S. multiflorum* is consistently two, the leaves are serrate, and the alternate bracteoles are situated somewhat below the hypanthium. *Symplococarpon chiriquiense* and the two following Central American species differ from the Mexican species in their densely hirsute ovaries (at the apex). The ovary of *S. Hintoni* has a few scattered hairs similar in type to those of the Central American species. However, in the other two Mexican species, *S. Airy-Shawianum* and *S. Purpusii*, the ovaries are strictly glabrous.

5. **Symplococarpon multiflorum**, sp. nov.

Arbor 20–25-metralis (fide *Austin Smith A487*), ramulis ferrugineis glabris, lenticellis sparsis vel nullis. Folia oblongo-obovata vel oblongo-elliptica, glabra, coriacea, 4–7 cm. longa et 1.5–3.0 cm. lata, supra nitida, subtus pallidiora, apice acuminata, basi cuneata, margine serrata, costa supra complanata, nervis ca. 7–8 paribus utrinque prominentibus, petiolis glabris 5–7 mm. longis. Flores ad 8–11 in fasciculis axillaribus; pedicelli glabri, recurvi, 10–12 mm. longi, bracteolis 2 subopppositis minutissimis ca. 0.5 mm. longis sepaloideis inaequalibus persistentibus; hypanthium glabrum, obconico-obovoideum, 2.0–2.5 mm. longum, calycis

lobis 5 inaequalibus imbricatis pergamenaceis glabris 1–2 mm. longis et 1.7–2.0 mm. latis, apice rotundatis vel flabelliformibus, ciliolatis; petala 5, inaequalia, imbricata, subrotundata vel obovata, 5–6 mm. longa et 4–5 mm. lata, margine incurvata; stamina ca. 25, uniseriata, filamentis ca. 3 mm. longis glabris, basi manifeste crassis et petalis adnatis, antheris ca. 0.75 mm. longis, mucro subulato ca. 0.25 mm. longo; ovarium fere totum inferius, bi-loculare, ovarii parte superiore dense albo-hirsuta; styli 2, liberi, ca. 3 (–5) mm. longi, glabri. Fructus ignotus.

COSTA RICA: Palmira, region of Zarcero, alt. 1800 m., *Austin Smith A487* (TYPE, AA; isotypes, FM, MBG), Oct. 5, 1937 (tree 75 ft. high, 3 ft. at the base; bark dark brown; flowers deep salverform, cream-colored; anthers ferrugineous). — La Junta (La Chonta), *H. E. Stork 2305* (FM), May 27, 1928. — Santa Maria, alt. 1700 m., *H. E. Stork 1808* (FM), May 5, 1928 (small roadside tree with yellow flowers).

As the name indicates, this species is characterized by its many-flowered fascicles, varying from four to nine. The bracteoles, in the type, are nearly opposite and are located just below the hypanthium. In *Stork 1808* the bracteoles are alternate, nearly 2 mm. apart in some instances, with the upper bracteole as much as 2 mm. below the hypanthium. However, this character is not consistent. The filaments of the stamens are enlarged at the base. This thickened portion, which is approximately 1 mm. long, approaches the anther in size. The leaves are coriaceous and serrate.

The collector of the type states that the specimen was taken from a large tree 75 ft. high, 3 ft. at the base. *Stork 1808* is described by the collector as a small roadside tree.

6. **Symplococarpon Brenesii**, sp. nov.

Arbor parva 4–6-metralis (fide Brenes), ramulis brunneis glabris lenticellatis. Folia lanceolata, glabra, coriacea, 4.0–7.5 cm. longa et 1.5–2.75 cm. lata, supra nitida, subtus pallidiora, apice acuminata, basi cuneata, margine serrata, costa supra complanata, venis ca. 7–9 paribus utrinque prominentibus, petiolis glabris ca. 5 mm. longis. Flores axillares, 1- vel 2- (rare 3-) fasciculati; pedicelli glabri, recurvi, 10–11 mm. longi, apice bracteolis 2 suboppositis inaequalibus sepaloideis minutis 0.5–0.7 mm. longis obtusis glabris persistentibus; hypanthium glabrum, obconico-obovoideum, ca. 2 mm. longum, calycis lobis 5 inaequalibus imbricatis glabris pergamenaceis 1.0–1.5 mm. longis et ca. 1.5 mm. latis, apice obtusis vel flabelliformibus, margine ciliolatis; petala

5, inaequalia, imbricata, obtusa ca. 5 mm. longa et 4.5 mm. lata, margine incurvata; stamina uniseriata, ca. 25, filamentis glabris ad 3 mm. longis, basi petalis adnatis et non incrassatis, antheris ca. 1 mm. longis, mucrone subulato ca. 0.5 mm. longo; ovarium fere totum inferius, ovarii parte superiore dense hirsuta; styli 2, liberi, ca. 3 mm. longi, parte inferiore hirsuti. Fructus (*Brenes 6228*) obovoideus vel subglobosum, subligneus, rugosus, ca. 8 mm. longus et 6 mm. latus, calyce stylisque persistentibus coronatus, apice excepto glaber, bi-locularis, 2-spermus; semen ovoideum, brunneum, ca. 4 mm. longum et 3.5 mm. latum, intus leviter concavum, extus hemisphaericum et rugosum basi apiceque obtusum.

COSTA RICA: La Palma y El Socorro de San Ramón, alt. 1175 m., *A. M. Brenes 4396* (TYPE, FM), August 27, 1925 (leaves ca. 9 cm. long and 3.5 cm. wide).—Same locality, woods and pastures, alt. 1180 m., *A. M. Brenes 4453* (FM), September 29, 1925 (tree 4–6 m. tall with spreading round crown; fruit immature).—Same locality, pastures and woods, alt. 1150 m., *A. M. Brenes 5151* (FM), November 24, 1926 (small tree with rounded crown; fruit blue, small).—Same locality, woods and pastures, alt. 1150–1175 m., *A. M. Brenes 5720* (FM), October 5, 1927 (small tree 4–5 m. tall, very branched; fruit axillary, isolated or in twos, green becoming black in drying, frequently 6–8 mm. long and 3–4 mm. diameter, surface rugose, pericarp thick, nearly woody; seeds ovoid, fleshy, light purple, 2 × 3 mm.).—Same locality, *A. M. Brenes 6228* (FM), July 24, 1928.

Symplococarpon Brenesii is characterized by glabrous, shining, coriaceous, serrate, lanceolate leaves. The flowers are somewhat smaller than those of the other Central American species and are disposed in fascicles of one or two, rarely three, flowers. The styles are hirsute along the lower half and the filaments of the stamens lack the basal thickening found to a marked degree in *S. multiflorum* and to a lesser degree in *S. chiriquiense*.

With the exception of *S. Airy-Shawianum*, this species is the only one in the genus to have been collected in fruit. All the specimens cited above, with the exception of the type, are fruiting specimens. Probably for the first time, mature or nearly mature fruit has been collected and recorded. A. M. Brenes, the collector, notes that the fruits are blue (no. *5151*). In the immature stage (no. *4453*) the fruit is oblong-obovate and probably green, with the hirsute apex and the persistent calyx-lobes clearly visible. On maturing (nos. *5151, 6228*), the two-seeded fruit appears more nearly globose, the pericarp becomes somewhat woody and thickened, and the small persistent calyx-lobes, although

still present and discernible, have become less obvious and lie appressed at the apex. It is quite difficult to decide from the mature stage whether the fruit is one-, two-, or even three-celled. However, in the immature stage (no. *4453*), the cross-sections show the fruit to be distinctly two-celled. I must confess that in my study of the mature fruit I was permitted, because of the paucity of fruit, to make very few actual sections.

This species is named after the collector, Professor A. M. Brenes, who, in the course of his collections in the San Ramón region, prepared the excellent series of specimens upon which the species has been based.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

MOMORDICA GROSVENORI SP. NOV. THE SOURCE OF THE CHINESE LO HAN KUO

WALTER T. SWINGLE

With two plates

IN 1932, while engaged in an agricultural survey of Kwangsi Province for the able and energetic military governor, Marshal Li Ts'ung-jen, Prof. George Weidman Groff of Lingnan University, Canton, China, discovered that the "lo han kuo," a plant widely used in household medicine in southern China, which he had been vainly seeking for many years, is cultivated in the mountains near the capital city of Kweilin by the non-Chinese Miao-tze people. Later, Prof. and Mrs. Groff visited the Kweilin region as guests of Marshal Li, who was born in this region and still maintains a residence there. On this trip visits were made to the Miao-tze villages but no living plants of the mysterious "lo han kuo" were seen. Marshal Li, however, sent a number of the swollen rootstocks to Prof. Groff at Canton, where they produced leafy shoots but no flowers, probably because of the high summer temperatures. These plants were the first of this species ever seen by botanists!

In order to learn exactly where and how the plant is cultivated, Prof. Groff requested a grant from the National Geographic Society through the late Dr. Frederick V. Coville, Chairman of the Research Committee, who with myself had been for many years anxious to find the source of "lo han" fruits and to identify the plant that produces them. Dr. Gilbert Grosvenor, President of the Society, approved the grant, and with the cooperation of Lingnan University of Canton, China, a special expedition, headed by Prof. Groff, was sent to Kweilin and vicinity in August, 1937.

The "lo han kuo" is a cucurbitaceous vine cultivated in northern Kwangsi by the Miao-tze people, who train it over horizontal trellises in special gardens cleared in the mountain forests. Abundant herbarium specimens and photographs of it were brought back by this expedition and turned over to me for identification. It became evident upon careful study of this material that it constitutes a new species of *Momordica* very distinct from any now known to botanists. I take pleasure in naming it *Momordica Grosvenori,* in honor of Dr. Gilbert Grosvenor, who for many years has encouraged liberally the geographic and botanical exploration of China.

Momordica Grosvenori sp. nov.

Ab aliis speciebus *Momordicae* differt seminibus applanatis radialiter striatis sulcatisque, margine rima lata profunde percursis, embryone ovato-lenticulari quam semine multo minore, fructus pulpa dulcissima in sicco in massam fibrosam levem coalescente, tota superficie plantae (facie superiore folii excepta) pilis minutissimis nigris ornata, folii margine sparse irregulariterque hydathodibus instructo.

A dioecious vine, climbing to 2–5 m., the roots perennial, tuberous, fusiform when young, finally subglobose, 10–15 cm. in diameter. Stems slender, the internodes 3–9 cm. long, the axillary tendrils 8–12 cm. long, bifid above the middle. Petioles slender, 2–7 (usually 3–5) cm. long, 1–2 mm. in diameter, longitudinally striate. Leaf-blades thin, ovate-cordate, sometimes hastate and nearly triangular in outline, 8–15 (rarely to 23) cm. long, 3.5–12 (rarely to 17) cm. broad, acute or acuminate at apex, deeply cordate-emarginate at base with a cuneate juncture with the petiole (see *pl. 2, fig. 1*), the margins entire, irregularly and coarsely crenulate, or shallowly lobed, very rarely with callose spathulate hydathodes projecting beyond the margins in continuation of veinlets, the lateral veins 4 or 5 pairs on each side of the midrib, the lower pair running close to the margin of the cordate sinus but soon branching into 3 or 4 strong veinlets, the 3 or 4 pairs in the upper part of the leaf-blades not showing such strong veinlets, the upper surface and margins with scattered short white or light buff hairs, the lower surface with similar hairs and also with characteristic widely scattered minute black hairlets (also found on all exposed surfaces of stems, tendrils, petioles, peduncles, pedicels, ovaries, and the outer surfaces of sepals and petals). Pistillate inflorescences clustered (2 or 3) in leaf-axils or sometimes solitary, either with simple pedicels bearing a single flower or with peduncles 3–5 cm. long bearing 2–5 flowers on pedicels 0.5–1.5 cm. long, the pedicels subtended by finely pubescent bracts 2–3 mm. long and 0.5–1 mm. broad, the bracts often caducous or lacking. Ovary inferior, oblong-ovoid, 8–10 mm. long, 3.5–4.5 mm. broad, rounded at base, 3-locular, with numerous ovules in 6 rows (see *pl. 1, fig. 2, 3, pl. 2, fig. 2*). Sepals 5, persistent, soon reflexed, 5–7 mm. long, 1.5–2 mm. broad at base, tapering into thread-like pubescent tips. Petals 5, free, thin, yellowish, lanceolate-acuminate, 20–23 mm. long and 6–7 mm. broad (in dried state), with 6 or 8 subparallel veins. Staminodes 3, slender, 2–2.5 mm. long, two of them paired, one single. Styles 3, 4–5 mm. long, 3-lobed, sometimes each lobe bifid (see *pl. 2, fig. 2*). Staminate inflorescence racemose, arising singly in leaf-axils, 9–13 cm. long, unbranched for 6–8 cm. at base, the upper portion bearing 4–15 more or less appressed pedicels 1–3 cm. long and 0.5–1 mm. in diameter, the

pedicels sometimes subtended by minute slender bracts 2–3 mm. long and 0.5–0.8 mm. broad. Staminate flowers single. Calyx funnel-shaped, 5-lobed above, the lobes 6–9 mm. long, 2.5–3.5 mm. broad at base, attenuate into slender thread-like finely pubescent tips. Petals 5, free, thin, yellowish, lanceolate-acuminate, 18–25 mm. long and 6–8 mm. broad (in dried state, possibly larger in fully developed fresh flowers), with 6 or 8 veins, two of the petals (nos. 1 and 2) bearing near the base bluntly rounded flaps (2–3 mm. long, 1.5–1.8 mm. broad, minutely pubescent above and ciliate at margins with nearly hyaline hairs, overlying those arising from the bases of the stamens). Stamens 3, two of them with a pair of anthers, the other with a single anther; filaments 3–4 mm. long (usually doubled above in the stamens with 2 anthers); anthers subtriangular, 4–5 mm. long, 2–2.5 mm. broad, extrorse, dull reddish brown on inner side, each anther with a single S-shaped pollen-locule with the outer descending arm longer (3 mm.) and the inner ascending arm shorter (2–2.5 mm.); filaments at base more or less irregularly expanded into sheets of tissue which extend under the petal-flaps and together with them almost completely cover the nectary. Fruits broadly ellipsoid, ovoid or subglobose, with broadly rounded ends, 6–11 cm. long, 3–4 cm. broad, more or less densely pubescent with yellowish (rarely reddish) hairs intermixed with numerous black hairlets, often with 6 (or more?) longitudinal stripes (see *pl. 2, fig. 6*), the peel very thin (0.5–0.8 mm. thick), the three doubled locules each with 2 rows of seeds (about 10–12 in a row) with slightly brownish gray pulp which dries to a light fibrous mass, intensely sweet in taste and with an aromatic odor and flavor (somewhat like licorice). Seeds light brownish gray, broadly oval or ovate, flattened, 15–18 mm. long, 10–12 mm. broad, 3–4 mm. thick at edges but with a depressed area (8–9 mm. long, 3–4 mm. broad) in the center of each side, surrounded by a ring of raised tissues which is radially striate and sparingly furrowed (see *pl. 2, fig. 4*), the margin deeply sunk as if eroded (see *pl. 2, fig. 4, 5*), the embryo ovate-lenticular, much smaller than the seed, 7.5–9 mm. long, 3.5–4 mm. broad, 1.8–2 mm. thick, the testa very thin; smooth (see *pl. 2, fig. 3*).

TYPE: CHINA: Kwangsi Province: Pai-shou (Po-seh) District, Niu-ho village, near Chien-kan, *Taam Ying-wah 1* (♀), 15 ft. tall, Aug. 17, 1937, cultivated in garden, 15 Chinese feet high, in Herb. National Arboretum; Dupl. Herb. Arnold Arboretum. Serial microtome sections S. and T. 508 A, slides 1–8 (longitudinal sections of half an ovary); 508 B, slides 1–12 (cross-sections of the other half of 508 A); 508 C, slides 1–20 (cross-sections of an entire ovary); 716 A, slides 1, 2, 716 B, slide 1 (cross-sections of leaves); all filed in type collection of Herb. National Arboretum.

ADDITIONAL MATERIAL: Kwangsi Province: Pai-shou District, Pao-an community near Pan-pu village, *Taam Ying-wah 69* (♂), PARATYPE, (in Herb. Nat. Arb. and Herb. Arnold Arb.). Serial microtome sections S. and T. 509 A, slides 1–7 (cross-sections of flower-bud); 509 B, slides 1–7 (longitudinal sections of flower-bud); 717 B, slide 1 (48 cross-sections of a flower-bud); 717 C, slides 1–7 (cross-sections of flower-bud); 717 D, slides 1–8 (longitudinal sections of flower-bud); 717 E, slides 1–33 (longitudinal sections of nearly mature flower); 717 A, slide 1 (cross-sections of leaf); all filed in type collection of Herb. Nat. Arb. Pai-shou District, Chih-lung village, *Taam Ying-wah 22* (♀) (in Herb. Nat. Arb. and Herb. Arnold Arb.). Boundary between Pai-shou and Kwei-lin Districts, Liu-ch'a mountains, alt. 2000 ft. (609 m.), *Groff, Hoh, & Tung 21172* (♀), Aug. 9, 1937, "Ch'ang han kuo" variety (in Herb. Nat. Arb. and Herb. Arnold Arb.). Boundary between Kweilin and Pai-shou Districts, Liu-ch'a mountains, *Groff, Hoh, & Tung 21173* (♀), Aug. 9, 1937 (in Herb. Nat. Arb.). Pai-shou District, San-wa village, near San t'ai mountain, *Taam Ying-wah 5* (♀), Aug. 18, 1937 (in Herb. Nat. Arb. and Herb. Arnold Arb.). Serial microtome sections S. and T. 729 A, slides 1–12 (cross-sections of young ovary); 729 B, slides 1–3 (cross-sections of young fruit); all filed in Herb. Nat. Arb. Clay slope near Pan-pu village of Po-an, *Taam Ying-wah 67* (♀), Aug. 27, 1937 (in Herb. Nat. Arb.), *Taam Ying-wah 71* (♀), "Ch'ang t'an tzu" variety (in Herb. Nat. Arb). Shih-lung village, *Taam Ying-wah 41* (♀), Aug. 22, 1937, "Ma ling tsu" variety (in Herb. Nat. Arb. and Herb. Arnold Arb.). Hsing-an District, Sai-on village, *T. S. Tsoong 83644* (♀), Aug. 27, 1937, young fruits red (in Herb. Arnold Arb.). Hsiang District, Yao Mountain, Ku-ch'ên, alt. about 5000 ft. (1570 m.), *Huang Chi 40248*, seen by Prof. Groff and Hoh Hin-cheung, marked "lo-han-kuo," with green fruits only (in Herb. Sun Yatsen Univ. no. 97307).

Kiangsi Province: Chung-jên District, near Li-pei-chiao, alt. 200–700 m., *Y. Tsiang 10200* (♀), July 7, 1932 (in Herb. N. Y. Bot. Gard.).

Kwangtung Province: Hainan Island, Chang-kiang District, O-kao (Ngo-ko) Mt., near Chin-ch'i (Tsat cha) village, *S. K. Lau 1925* (♂), June 12, 1933 (in Herb. Arnold Arb., Gray Herb., and Herb. Nat. Arb.). Hainan Island, Kan-ên (Kum-yun) District, *S. K. Lau 27685* (♂), Aug. 18, 1936; "fruit scarlet" (on ♀ plants) (in Herb. Arnold Arb.). Serial microtome sections S. and T. 721 A, slide 1 (cross-sections of leaf); 721 B, slides 1–7 (cross-sections of flower-buds); 721 C, slides 1–4 (longitudinal sections of flower-buds); all filed in Herb. Nat. Arb.

The two collections of wild plants growing in Hainan Island were studied by Dr. E. D. Merrill, Director of the Arnold Arboretum, and by Dr. Franklin P. Metcalf, Botanist of Lingnan University at Canton, China, and were found by them to represent a new species of cucurbitaceous plant native in China. When it became obvious that these Hainan plants belonged to the same species as the one cultivated in Kwangsi province, the dried material, notes, and drawings of the Hainan material were turned over to me so the species could be based on the more abundant collections of both male and female plants. I wish to take this occasion to render thanks for this most generous action.

As appears from the above enumeration of the known material, *Momordica Grosvenori* is known from three rather widely separated regions in southwestern China: (1) the mountains westward from Kweilin in the northeastern part of the province of Kwangsi, where it is intensively cultivated in several districts at altitudes of 600 meters and over (found growing wild at 1570 meters); (2) about 600–700 kilometers northeast of Kweilin in the north-central portion of Kiangsi Province in Chung-jên district southwest of Yang-po lake, at altitudes of 300–700 meters; (3) about 700 kilometers south of Kweilin in two districts of Hainan Island at altitudes of 610 meters or over. In Kwangsi province it grows in the mountains in shady forests where *Cunninghamia lanceolata,* the tea-oil tree, *Thea sasanqua,* and the wood-oil tree *Aleurites Fordii* are native. In these foothill mountain forests, rains and fogs are frequent in the summer season. "Lo han kuo" tubers transplanted by Groff from Kweilin to Canton near sea level gave rise to vigorous vines but did not flower.

Four principal varieties of the "lo han kuo" are grown in the Miao-tze country, where they are propagated by dividing the tuberous roots. These varieties show rather striking differences in the shape and color of the fruit and in the shape and size of the leaves, and also in the degree of evenness of the leaf-margins. In some varieties a very few hydathodes can sometimes be detected along the leaf margins, but more often they are wanting entirely. Nothing is known as to the fruit characters of the wild plants of *Momordica Grosvenori.* The leaves of the Kiangsi province plant (*Y. Tsiang 10200*) are the largest known, reaching 23 cm. in length and 13 cm. in width. Those of the Hainan Island plant (*S. K. Lau 1925*) are the smallest, 6.5–8 by 3.5–5 cm. Male plants are not cultivated by the Miao-tze people and for this reason are seldom seen. Flowers collected from the wild plants growing in the mountains are used by the Miao-tze people to pollinate the cultivated female plants.

Momordica Grosvenori, in common with a number of other species of *Momordica,* has the double nectary protection by two basal petal flaps

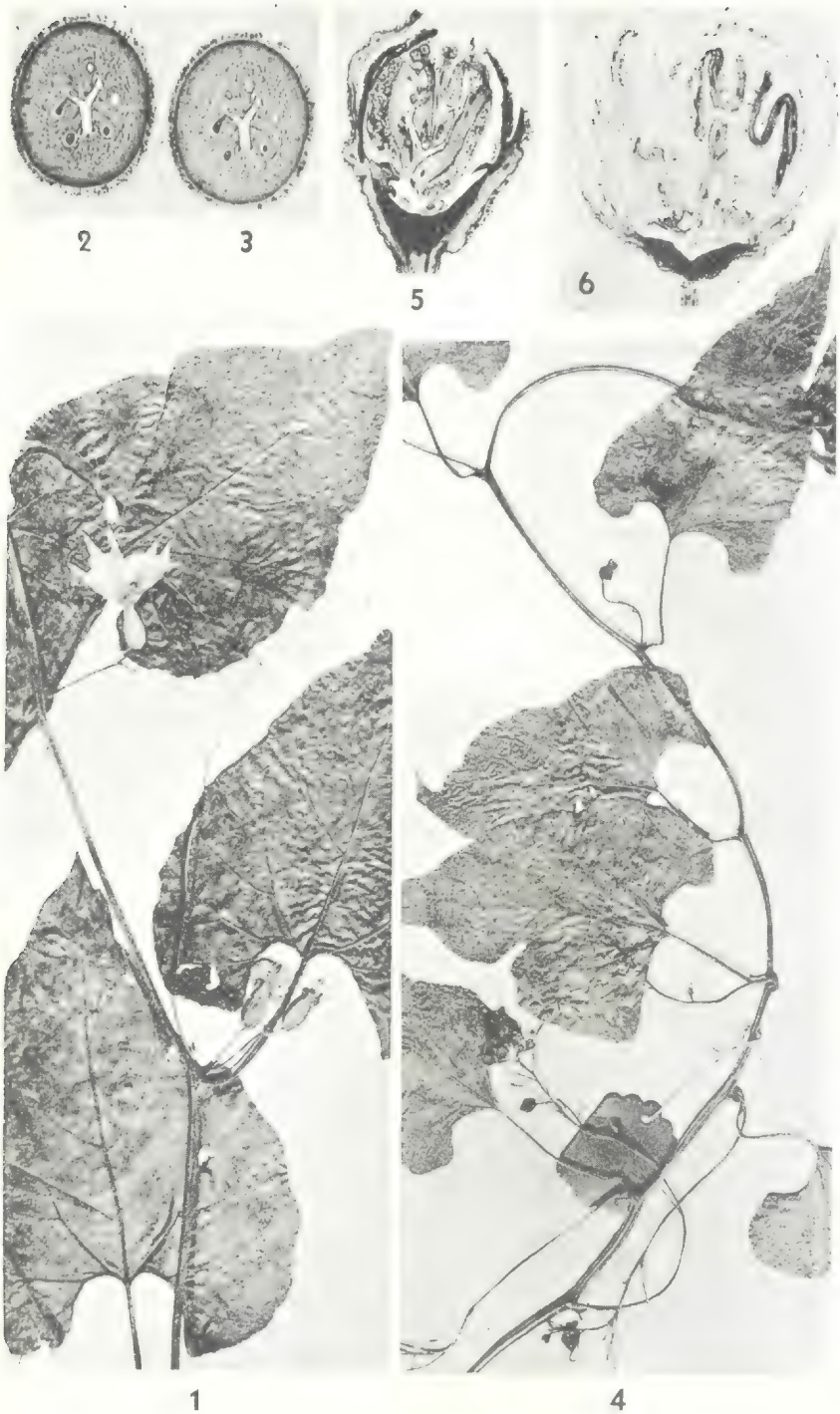
supplemented by broad proliferations from the bases of the 3 stamens, very similar to that described and figured in *M. trifoliata* by A. Zimmermann (Die Cucurbitaceen **2**: 61–62. *fig. 44, 45.* 1922). Several other species of *Momordica* studied in minute detail in East Africa by Zimmermann show striking homologies with *M. Grosvenori* in the morphology of the male flowers.

A species of *Momordica* native to northern French Indochina, *M. tonkinensis* Gagnep. (in Bull. Mus. Hist. Nat. Paris **24**: 376. 1918; figured in Flore gén. de l'Indo-Chine **2**: 1070. *fig. 120* [*5–8*]. 1921), presents certain analogies to the "lo han kuo," and may prove to be a somewhat related species. The general appearance of this plant is evidently much like that of *M. Grosvenori* and its leaves are said to be "atro-glandulosa" on the under side, but it is not stated whether this is due to the presence of scattered black hairs as in the "lo han kuo." The fruits are unknown and the male inflorescences differ from those of the "lo han kuo" in having a very short corymb containing 12–15 flowers borne at the end of a peduncle 9–11 cm. long. It is described as having five free stamens. The male flowers have broad and rather bluntly pointed sepals very different from those of *M. Grosvenori,* which has the sepals long-acuminate, ending in slender thread-like tips.

The "lo han kuo" is a small gourd-like fruit having an intensely sweet taste, widely used by the South Chinese as a household remedy for colds, sore-throat, and minor stomach and intestinal troubles. From the studies of Prof. Groff and his Chinese assistants, it appears that about 1000 tons of the green fruits are delivered every year to the drying sheds at Kweilin. The fruits lose much weight in drying and are then packed in boxes and shipped to Canton where most of the crop is consumed, but large numbers of the "lo han" fruits are exported to the Cantonese living in the United States and other over-sea countries.

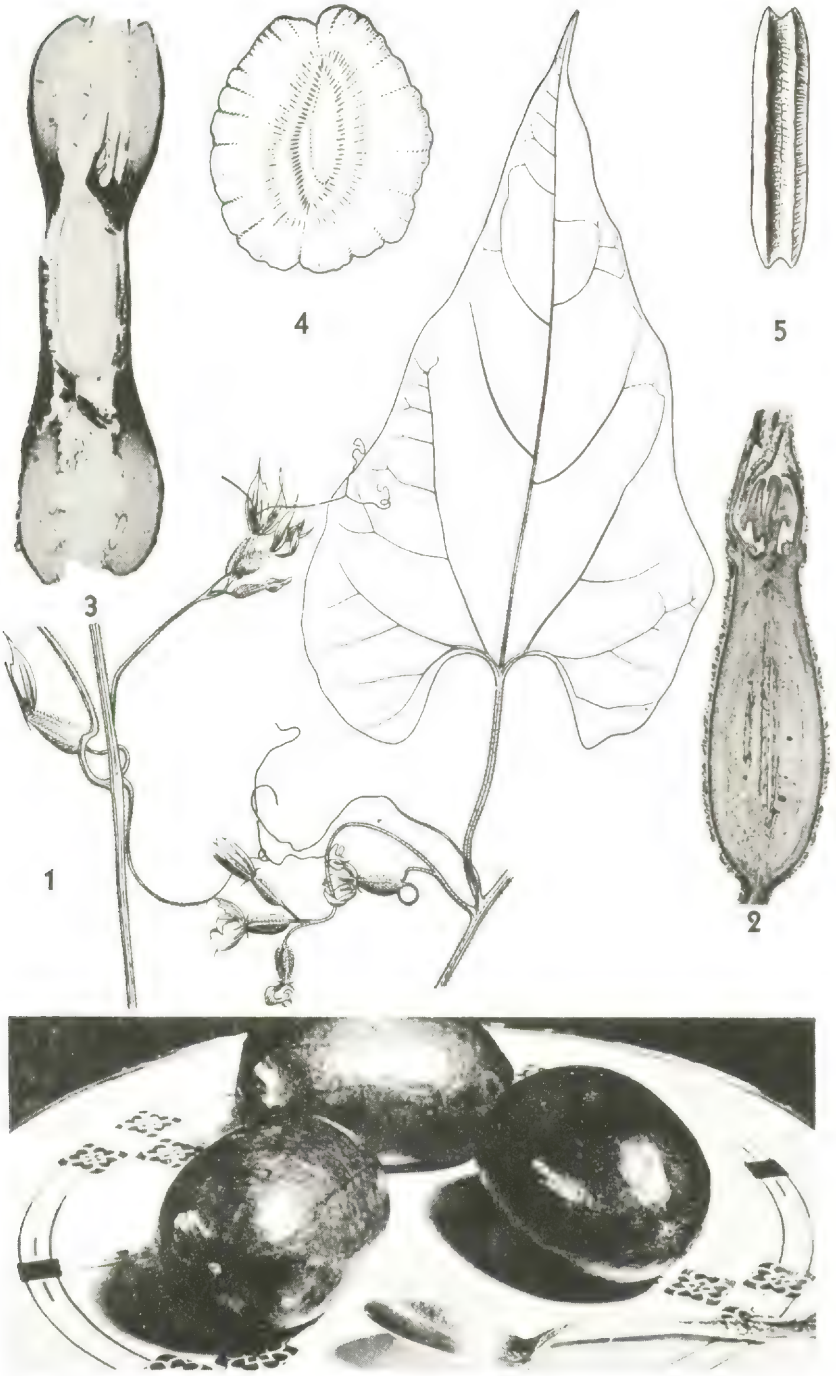
Professor Groff was able to secure seeds of the "lo han kuo" near Kweilin in 1937 and found they retained their viability for a long time. Some of the seeds were planted at Lingnan University, Canton, China. The young seedlings soon developed fusiform roots. Half a dozen of these roots were recently presented to the Division of Plant Exploration and Introduction of the Bureau of Plant Industry by Professor Groff[1] through the National Geographic Society. It is hoped that these plants

[1]I wish to render here grateful acknowledgment to Professor G. Weidman Groff, not only for these living plants, but also for all of the details mentioned in this paper regarding the culture and curing of the "lo han kuo," which were taken from a manuscript report by Groff and Hoh on their trip to northern Kiangsi made in 1937. This report was put in my hands by Dr. Gilbert Grosvenor, President of the National Geographic Society, in order to aid me in determining the taxonomic status of this plant.



MOMORDICA GROSVENORI Swingle

FULL-TONE — MERIDEN



MOMORDICA GROSVENORI Swingle

FULL-TONE — MERIDEN

represent both sexes and that cuttings from them may be tested at different altitudes and different climates in hope of finding localities in the United States where this remarkable plant can be grown successfully. This will permit much better material than that now available to be obtained for use in determining its relationships in the genus *Momordica*.

EXPLANATION OF PLATES

PLATE 1

Momordica Grosvenori Swingle. Female plants: Fig. 1, *Taam 22;* Fig. 2, 3, type, *Taam 1.* Male plant: Fig. 4, 5, 6, paratype, *Taam 69.*

FIG. 1. Flowering twig. × ½.

FIG. 2, 3. Serial microtome cross-sections of ovary, showing 3 locules, each with 2 rows of ovules, also both pale yellow and black hairs covering the outer wall. × 6.

FIG. 4. Flowering twig, showing slender racemose ♂ inflorescences. × ½.

FIG. 5. Longitudinal microtome section of ♂ flower-bud, showing petal flap (right) and growth starting to form at base of filament (left). × 6.

FIG. 6. Longitudinal microtome section of nearly mature ♂ flower showing (to right) petal flap which overlaps the proliferation at base of the staminal filament growing over the nectary, also 2 S-shaped pollen-locules of 2 anthers. × 3.

PLATE 2

Momordica Grosvenori Swingle. Female plants: Fig. 1, 2, *Taam 22;* Fig. 3, seed from a fruit purchased in a Chinese shop in San Francisco: Fig. 4, 5, *Taam 71, Ch'ang t'an tzu* variety, from Jose Gomez' drawing No. 17; Fig. 6, three cured fruits of the *Ch'ang t'an tzu* variety, Groff photograph No. 1206.

FIG. 1. Flowering branch, showing ♀ inflorescences with flower-buds and flowers, from Jose Gomez' drawing No. 9. × ½.

FIG. 2. Longitudinal microtome section of young ovary showing numerous ovules, 3-parted style, and abundant small pale yellow and black hairs covering outer wall, microtome section. × 10.

FIG. 3. Cross-section of mature seed showing the outline of the small embryo and the collapsed tissues of the erose margin. × 6.

FIG. 4. Mature seed showing radial striae and furrows, also depressed area over the embryo in the center. × 2.

FIG. 5. Side view of seed showing erose margin. × 2.

FIG. 6. Cured and polished fruits of *Ch'ang t'an tzu* variety. × ½.

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

NEW SPECIES OF MALLOTUS

FRANKLIN P. METCALF*

IN this paper four new species and one new variety are proposed, and in addition one new combination is made. In the group with densely tomentose stems and capsules a key is added to distinguish the closely related species.

The writer wishes to thank Dr. E. D. Merrill, Director of the Arnold Arboretum, for facilities made available during the progress of this work, and Dr. Leon Croizat, specialist in the Euphorbiaceae, for his friendly criticism of the manuscript.

1. **Mallotus apelta** (Lour.) Müll.-Arg. var. **kwangsiensis** Metcalf var. nov.

Mallotus sp. in discussion under *Mallotus Stewardii* Metcalf in Lingnan Sci. Jour. **10**: 489. 1931.

Mallotus apelta Croizat in Jour. Arnold Arb. **19**: 142–3. 1938, *quoad spec. cit. e* Kwangsi, *Ching 7111, non* Müll.-Arg.

A typo speciei differt aculeis capsulae multo longioribus flavidis nec albis.

Capsular spines much longer than in the species, giving a looser, less compact appearance to the ♂ inflorescences, and yellowish in color rather than pearl-white. The peduncle of the ♂ inflorescence is also unusually long, up to 16 cm. As Croizat (l. c.) has pointed out, it resembles somewhat the Bornean and Javanese material of *Mallotus ricinoides* Müll-Arg.

KWANGSI: Yeo Mar Shan, N. Hin Yen, 4000 ft., *R. C. Ching 7111,* TYPE, Aug. 24, 1928, in open wood, tree, 25 ft.

Fan & Li 4, from Chang Ning Hsien, Hunan, may also belong here, but is not an exact match. Possibly it may represent a form of *Mallotus Paxii* Pamp. Further field work will be necessary before the relationships of this specimen from Hunan can be established. New collections from Kwangsi, Hunan and Tonkin may help greatly to clarify the limits within this group.

2. **Mallotus Croizatianus** Metcalf sp. nov.

Arbor usque ad 7 m. alta; ramulis villoso-tomentosis, ultimis 7–10 mm. diametro; foliis alternis, peltatis, palmatinerviis, chartaceis, late

*Fellow (1940) John Simon Guggenheim Memorial Foundation; Curator of Herbarium, Botanical Survey, Lingnan University (on leave).

ovatis vel subrotundatis, 20–40 cm. longis et 20 cm. latis, elobatis vel 1–3-lobatis, lobis lateralibus breviter triangulari-acuminatis, lobis terminalibus gradatim acuminatis vel caudato-acuminatis, basi rotundatis, supra subglabris, subtus tomentosis, nervis 7–9; petiolo variabili, in foliis superioribus 2–5 cm. longo, in foliis inferioribus maturis ad 20 cm. longo, dense villoso-tomentoso; ♂ inflorescentiis paniculatis; ♀ inflorescentiis, racemosis congestis, dense tomentosis; floribus ♂ : sepalis ellipticis, 3.5 mm. longis et 2 mm. latis, dense stellato-tomentosis; staminibus multis, plus quam 120; ♀ floribus: sepalis 4, lanceolatis, acuminatis, 4–4.5 mm. longis, dense stellato-tomentosis; stylis 3, exsertis, recurvatis, stigmatibus piloso-subfimbriatis; fructibus globosis, ad 2 cm. diametro, aculeis dense stellato-tomentosis apice glabris, brunneis; pedicello stellato-tomentoso, 2–4 mm. longo.

KWANGSI: En route Liang-chiang to Pai-shan city, Pai-shan district, *Y. W. Taam 4,* TYPE ♀, Aug. 17–18, 1937, abundant among shrubs on dry, rocky, sandy soil of Chien-kan-shan, near Niu-lo ts'un, erect woody plant, 2 m. high with fragrant, yellow flowers, "P'ao-mu-shu." Shap Man Taai Shan, near Ping Hoh village, S.E. of Shang-sze, Kwangtung border, Shang-sze district, *W. T. Tsang 22132,* ♂, April 17, 1922, abundant in meadow along roadside or in dry clay, woody, 4 ft., fl. yellow. Na Hung, Ling Yün Hsien, *A. N. Steward & H. C. Cheo 356,* May 7, 1933, ♂, shrub, 7 m. with yellow flowers; specimen also with portion of bark, ex Herb. Univ. Nanking.

3. **Mallotus Dunnii** Metcalf sp. nov.

Mallotus Roxburghianus Müll.-Arg. var. *glabra* Dunn in Jour. Linn. Soc. Bot. **38**: 365. 1908; Pax & Hoffmann, Pflanzenr. (Heft. 63) IV. **147.** VII: 173. 1904 *in nota* (as var. *glaber* Dunn); Croizat in Jour. Arnold Arb. **19**: 144. 1938.

FUKIEN: Yenping, Buong-kang Village, *Dunn 1136-HH 3437* (HK, K, AA.)

This material is so distinct that it should not be retained as a variety. Furthermore, the specimen cited above does not have the pubescence characteristic of *Mallotus Roxburghianus* Müll.-Arg. The leaves are small, peltate, palmately 8–10-nerved, subrotund, with 1–3 lobes at the apex, glabrous on both sides with the base of the leaf rotund and the lobes acuminate; the blades are approximately 18 cm. long and 15 cm. wide; the petioles are 8–15 cm. long; the inflorescence is terminal, racemose, with slender pedicels (0.5–3.5 cm. long), with the lowest pedicels distinctly the longest.

The specimen seen by Croizat and myself in the herbarium of the Arnold Arboretum is sterile. The description of the inflorescence is

based on my notes taken in the herbaria of Kew and of the Hongkong Botanical Garden.

4. **Mallotus lotingensis** Metcalf sp. nov.

Mallotus barbatus (Wall.) Müll.-Arg. var. *congestus* [*congesta*] Metcalf in Lingnan Sci. Jour. **10**: 487. 1931.

KWANGTUNG: On way to San Kai Tin, Loting, *Ying Tsiang 1131,* Sept. 13, 1928. Sunyi, *Ying Tsiang 2734,* June 17, 1929, in open, along water, shrub. (Both formerly distributed as *M. barbatus* Müll.-Arg.). *Squire 317* from Hue, Indo-China, a ♂ specimen, probably also represents this species.

Croizat (in Jour. Arnold Arb. **19**: 135. 1938), in his discussion under *M. barbatus* var. *pedicellaris* Croizat, has suggested that *M. barbatus* var. *congestus* Metcalf is a form that has sessile or subsessile fruit on a congested inflorescence, and that it is doubtfully conspecific with his new variety, adding that "it is probable that a better knowledge based on more ample collections of Chinese *M. barbatus* will introduce further changes in the treatment and limits of the species."

After making an additional study of this material along with some new material not available in 1930–31, I have come to the conclusion that this is in reality a good species and not a variety. It is much nearer in its relationships to *M. luchenensis* Metcalf from Kwangsi, Hunan, and Kwangtung, than to *M. barbatus* from Yunnan, Szechuan, Annam, and Cochinchina. The leaves, young branches, petioles and inflorescences are densely stellate and soft velvety-tomentose beneath. The ♀ inflorescence is a congested eglandular raceme, and the capsules are sessile, stellate-pubescent, with the spines quite noticeable.

5. **Mallotus luchenensis** Metcalf sp. nov.

Arbor vel suffrutex usque ad 3 m. altus; ramis farinoso-tomentosis, ramulis villosis, dense tomentosis, flavis vel flavo-ferrugineis; foliis late ovatis vel subrotundatis, 15–30 cm. longis, 10–15 cm. latis, 3-lobatis, lobis rare nullis vel uno laterali, lobo terminali triangulari-acuto vel acuminato, lobis lateralibus acutis vel caudato-acuminatis, basi cordatis vel rotundatis vel truncatis, supra, nervis exceptis, subglabris, subtus dense stellato-tomentosis, pilis in foliis maturis albis, in foliis juvenilibus ferrugineis; petiolo usque ad 10 cm. longo, dense tomentoso-pubescente; inflorescentiis terminalibus, elongato-racemosis, ad 30 cm. longis, dense stellato-tomentosis; ♂ inflorescentiis: sepalis ellipticis, stellato-tomentosis; staminibus numerosis; ♀ inflorescentiis elongato-racemosis; sepalis ovatis, stellato-tomentosis; stylis 4, recurvis exsertis: stigmatibus papilloso-fimbriatis; fructibus subglobosis, leviter denseque stellato-

tomentosis, 10 mm. longis latisque; pedicello 6–10 mm. longo, dense tomentoso; calyce et stylis persistentibus; aculeis totis massam unam efformantibus, brunneo-nigris, minute glandulosis, pilis confertis stellato-tomentosis undique indutis.

KWANGSI: Shan Fang, N. Luchen, 1500 ft., *R. C. Ching 5699,* June 6, 1928, TYPE ♀, in open thicket, spreading shrub, 10 ft., with gray bark. KWANGTUNG: Ting Wu Shan, *W. Y. Chun 6342* ♂ and *6400* ♀ (2 sheets), May 5 and 6, 1928, in open shrub, or light woods; tree 2.5–3 m. high. KWEICHOW: Ad viam Tschenning Huangtsaubam fluminis Houdjiau ho in silva lateris australis, *Handel-Mazzetti 10364,* June 20, 1917; Tuyun, *Y. Tsiang 5766,* July 12, 1930, in dense shade, tree 6 m. high, diam. breast high, 15 cm., sterile specimen.

INDO-CHINA: Tonkin, prov. Santay, *Petelot 2218,* ♀, June, 1939, tree 7–8 m.

This species was formerly confused with *Mallotus barbatus* Müll.-Arg. and its variety *congestus* Metcalf (= *M. lotingensis* Metcalf). It is, however, probably more closely related to *M. lotingensis* from Kwangtung than it is to either the species *M. barbatus* or its variety *pedicellaris* Croizat. This species has leaves similar to *M. barbatus*, but the fruits are short- rather than long-pedicelled, and the capsules are reddish or reddish orange, not yellowish or straw-colored. From *M. lotingensis* it can be distinguished by the pedicelled, not sessile, capsules in loose, not congested, racemes.

6. **Mallotus philippensis** (Lam.) Müll.-Arg. var **reticulatus** (Dunn) Metcalf comb. nov.

Mallotus reticulatus Dunn in Jour. Linn. Soc. **38**: 365. 1908.

Pax & Hoffmann, in Pflanzenr. (Heft. 63) IV. **147**. VII: 184. 1914, have listed *Mallotus reticulatus* Dunn as a synonym of *M. philippensis* Müll.-Arg. *Mallotus reticulatus,* in my opinion, is not typical *M. philippensis* Müll.-Arg. On the other hand, it should not be treated as a distinct species. If *Dunn 3429* from unexplored western Fukien were the only collection available to me, I might still consider it a good species, but another specimen collected by Ford in Hongkong shows a dentation which is not quite so pronounced. Both specimens, nevertheless, are characterized by coarsely dentate leaves, hardly serrate, as stated by Dunn (l. c.). *Dunn 3429* has more deeply dentate leaves, which are coriaceous, distinctly and finely reticulate, and with a very peculiar yellowish bloom in addition to the usual red granular glands and pubescence beneath. The specimen is also much more densely pubescent.

The yellowish bloom and prominent reticulate lower surface of the leaves are the most distinctive characteristics.

WESTERN FUKIEN: Wong Ka Chi, *Dunn 164-HH 3429,* TYPE of *M. reticulatus* Dunn (HK, AA). KWANGTUNG: Lung-tau-shan, *LU 12890 (To & Tsang)* (CCC; fragment, AA). HONGKONG: *Ford* (AA).

One sheet from Futschau (Foochow) collected in 1887, namely *Warburg 5876,* has leaves with a somewhat dentate margin, but these leaves are subcoriaceous, much thinner than those of the typical variety, and lacking the yellowish bloom and the somewhat distinct raised reticulations; hence is placed here with doubt.

Below I am adding a key to characterize and distinguish the species in the "*barbatus*" group, namely *M. barbatus* Müll.-Arg., *M. barbatus* var. *pedicellaris* Croizant, *M. luchenensis* Metcalf, *M. lotingensis* Metcalf, and *M. Croizatianus* Metcalf.

KEY TO THE "BARBATUS" GROUP OF MALLOTUS

a. Spines of capsule forming a continuous stratum.
  b. Capsules yellowish.
    c. Pedicels short, 1 cm. or less, mostly less; capsules about 12 mm. diam.; branchlets shaggy-tomentose (Yunnan, Szechuan). ..... *barbatus* Müll.-Arg.
    cc. Pedicels longer, 1–4.5 cm.; capsules 15–16 mm. diam.; branchlets tomentose (Szechuan). .. *barbatus* var. *pedicellaris* Croizat
  bb. Capsules reddish or reddish orange; branchlets rather shaggy-tomentose (Kwangsi, Kwangtung, Tonkin).. *luchenensis Metcalf*
aa. Spines of capsule not forming a distinct stratum but appearing somewhat echinate.
  b. Capsules about 1 cm. diam. and somewhat congested or confluent in the spike; branchlets shaggy-tomentose (Kwangtung and Annam). ..... *lotingensis* Metcalf
  bb. Capsules about 2 cm. diam., scattered, not congested or confluent; branchlets shaggy-tomentose (Kwangsi). .. *Croizatianus* Metcalf

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

RELCHELA PANICOIDES STEUDEL GRAMINEAE ENDEMICA EN CHILE[1]

CARLOS MUÑOZ[2]

Con una lámina

DURANTE las observaciones sobre algunos géneros de Gramineae representados en Chile, Dr. Agnes Chase nos llamó la atención sobre las características peculiares de *Relchela panicoides* Steudel, haciéndonos ver las posibilidades de reconocer este género mono-específico en su verdadero valor taxonómico y filogénico. La abundancia de material crítico encontrado en el Herbario de Gramíneas del Museo Nacional de los EE.UU. nos indujo a efectuar un estudio sobre el mencionado tema.

Relchela Steudel (20) es un anagrama creado por el autor a base de Lechler, colector de la especie. *Lechlera,* nombre inédito, solo ha sido mencionado por Steudel en correspondencia a botánicos y amigos suyos.

Desde la época de su creación (1854) el género ha sido mal interpretado. Su única especie, *Relchela panicoides* Steudel, descrita en Paniceae, ha sido incluída en el género *Calamagrostis* y sus sinónimos descritos en *Panicum* y *Agrostis.*

Bentham (2: 91) la incluye por primera vez en *Deyeuxia* Clarion (*Lachnagrostis* Trinius), comentando que "*Relchela,* Steud., . . . *Cinnastrum,* Fourn. (at least as to *Deyeuxia poaeformis,* Kunth.), *Deyeuxia mutica,* Wedd., and *D. breviglumis,* Benth., with a few other South-American species, form a little group with a glabrous rhachilla and the awn reduced to a small point." Al mismo tiempo indica *Agrostis sesquivalvis* Desv. (error para *A. sesquiflora* del mismo autor) como sinónimo.

Bentham & Hooker (3: 1153) la menciona como *Deyeuxia,* hoy dia considerada sub-sección de *Calamagrostis,* indicando una vez más *Agrostis sesquiflora* como sinónimo.

Hackel (11) la sigue considerando *Calamagrostis* (§ *Deyeuxia*), haciendo notar su anomalía dentro de ella. *Index Kewensis* (15) la anota también bajo *Deyeuxia,* y Dalla Torre & Harms (9) la coloca bajo *Calamagrostis* Adans. Bews (4) adopta la misma opinión de Hackel.

[1]Leído ante la sección respectiva del Congreso Científico Americano, el 17 de Mayo de 1940, en Washington, DC.

[2]Manuscrito realizado bajo el auspicio de John Simon Guggenheim Memorial Foundation, durante la renovación de la beca latino-americana para Chile, con que fué agraciado durante 1939–40.

Ultimamente Pilger (19) crea una nueva sección del género *Briza* (§ *Relchela*), basando su nueva combinación específica en *Agrostis sesquiflora* Desv., atendiendo seguramente a la opinión de los autores anteriormente citados.

Estos antecedentes fundamentados en consideraciones a priori, sin la consulta previa de material crítico, y la diagnosis genérica y específica dada por el autor (errónea y poco precisa) crearon una confusión en la interpretación de *Relchela*.

Sus caracteres quedan perfectamente bien definidos por la posición y número de antecios (1–2), compresión lateral y consistencia perfectamente indurada de la glumela, apenas 5–7-nerviada, callo robusto, coronado de pelos tiesos, raquilla prolongada y pubescente, caryopsis hirsuto en el ápice e hilio basal, lanceolado-linear. Consideramos *Relchela panicoides* perteneciente a la tribu Festuceae, sub-tribu Festucinae.

El género y la especie son endémicos en Chile, con una distribución geográfica comprendida entre Aconcagua y Llanquihue, desde la costa al valle central. La época de floración, de acuerdo con el material que nos ha sido posible estudiar, varía desde Diciembre a Febrero.

Durante la disección de las espiguillas de un solo antecio, notamos la presencia de caryopsis completamente desarrollados y anteras de tamaño muy reducido, que agrupadas y entremezcladas con el resto de estigma coronaban su ápice. La glumela y la palea se unían por sus bordes fuertemente, y la separación de la primera se hacía dificultosa debido a su consistencia estremadamente coriácea. Este hecho nos hace reconocer un fenómeno de cleistogamía en esta clase de elementos. Hemos tratado de ilustrar esta característica, común en otros géneros americanos, en la lámina que adjuntamos, en la que puede apreciarse el tamaño de las anteras en los antecios cleistógamos y aquellos normales.

En el material estudiado, la especie encierra también un complejo de variaciones, que aparentemente podrían tomarse como fijos. Por ejemplo, la glumela se presenta algunas veces completamente escabra en la mitad inferior (*Buchtien,* Valparaiso, US. no. 1099593); otras veces, la forma generalmente aovada de la glumela se inclina a lanceolada (*Joseph 5113*). Los antecios son en la mayoría de los especímenes más cortos que las glumas; en cambio en el material citado anteriormente el primer antecio tiene el mismo largo que las glumas y el segundo sobresale bastante de ellas, lo que afirma su posición dentro de la tribu. La palea es más corta que la glumela y otras veces de su misma dimensión. La longitud de las anteras presenta ligeras variaciones respecto de las anotadas.

Hemos creído necesario dar a conocer en detalle la discusión de cada

uno de los tipos y presentar una diagnosis completa basada en material crítico, con el fin de aclarar su valor taxonómico.

Relchela panicoides Steudel, Syn. Pl. Gram. **1**: 101. 1854.

El tipo se encuentra conservado en el Herbario del Museo de París. El ejemplar colectado por Lechler, no. *435*, Arique, Chili, Dc. 51, con la etiqueta de Lechler, lleva otra que dice, "*Relchela panicoides* Steudel (*Lechlera,* seguido de un nombre específico inédito), *Lechlera* Miq. est aliud genus. Prope Arique Chili. *Lechler* Hrbr. no. *435*" [manuscrito del autor]. Está formado por dos ejemplares de 60 cm. de altura (culmo de uno de ellos quebrado), perenne; grupos pequeños de pocos a varios culmos; hojas lacias, aplanadas, de 3 mm. de ancho; panículas sobremaduras, de 5–9 cm. Las espiguillas llevan un solo antecio; el ovario completamente desarrollado, y anteras pequeñas coronando su ápice. Una segunda hoja correspondiente al mismo colector y número la forman ejemplares pequeños, más jóvenes; culmos de 25–40 cm., designados por Steudel con un nombre varietal inédito.

Isotipos de la especie se encuentran (1) en U. S. National Herbarium (US. no. 1127141), ex Wien. Nat. Mus. (W). "W. Lechler pl. chilensis. Ed. R. F. Hohenacker, *435, Relchela panicoides* Steudel, novum. Panicearum genus, *Relchela* anagramma e Lechlera, prope col. Arique et pr. Techa. Dec. m. 1851." Es un ejemplar completo bien conservado, de dos culmos y mostrando la presencia de estolones; (2) en el Jardín Botánico de Leningrado (LE), fragmento en US., obtenido por Hitchcock, en 1907; (3) en el Herbario de Cambridge, Inglaterra (CGE), Chili (Arique) *Lechler 435,* obtenido por Prof. Hitchcock; (4) en el Herbario Pittier & Durand, Bruselas (BR) (*Lechlera,* seguido del mismo nombre específico inédito), "*Relchela panicoides* Steudel" Valdivia, Chili, *Lechler* (Hohenacker) *435,* nombre manuscrito por el autor; fragmento obtenido por Hitchcock en 1935; (5) en el Herbario del Museo Nacional de Historia Natural, Santiago, Chile (SGO), Herbario Philippi. Según Espinosa[3] existe otro ejemplar colectado en "Arique (Valdivia) en 1851." También en US. no. 1761967, en hoja separada, se encuentran 4 ejemplares completos, de panículas delgadas y reducidas, W. Lechler pl. chilensis, Ed. R. F. Hohenacker, *435, Relchela panicoides* Steudel, n. gen., "in virgultus prope Arique. Novembr.m.1853" (Nótese que el año, mes y anotaciones difieren de la etiqueta considerada original).

Planta perenne, raíz fibrosa, estolonífera, innovaciones extravaginales, 20–60 cm. de altura, formando grupos de pocos o varios culmos. Estos

[3]Según M.R. Espinosa, también existe bajo esta misma denominación en SGO un ejemplar colectado en "Huallihuapi" ad originem Rio Futa (Valdivia).

cilíndricos, erectos o algo geniculados en la base,[4] de 0.8–1 mm. de diámetro, retrorso-escabros, de 2 nudos visibles, separados entre 12–13 cm., circulares, negruzcos, de 0.3 mm. de ancho, desnudos. Vaina glabra o muy escasamente pubescente, amarillenta, estriada, más corta que la lámina, 4–10 cm., envolviendo o no por completo el culmo. Lígula 2 mm. de largo, blanquecina, membranosa, pubescente al interior, decurrente sobre la vaina. Lámina plana, la inferior 15–20 cm., 2–3 mm. de ancho, lanceolada-acuminada, de 13–15 nervios prominentes, escariosos; la superficie inferior de las más maduras cubierta en los nervios de apéndices largos, blanquecinos, separados. Algunas veces, la lámina superior del culmo de 6 cm. de largo, alcanzando a la mitad de la panoja. Panícula contraída, erecta, 4–8 cm., por 3–5 de ancho; las ramificaciones escariosas, ascendientes, en verticilos de 3–5, separados entre 1.5–2 cm.; el verticilo más corto de 0.5 cm., y el más largo de 2 cm.; cada ramificación principal o secundaria desnuda inferiormente. Espiguillas 1–2 antecios, el primero sésil, incluído por completo por las glumas, el segundo en una raquilla igual a la mitad del primero, ambos hermafroditas. Glumas aquilladas, casi iguales, de márgenes membranosos, transparentes, de bordes enteros o muy finamente aserrados; carena escariosa; la inferior de 4–4.5 mm. y 0.5 mm. de ancho, 1-nerviada; la superior 4.3–4.5 mm. y 0.5 mm. de ancho, 3-nerviada en su base. Glumelas cilíndricas y dorso encorvado, 3.3–3.5 mm. y 0.4 mm. de ancho, de ápice obtuso, y el nervio medio no sobresaliendo entre los lóbulos de ella, induradas, gruesas, con la base coronada de pelos cortos, de bordes escariosos, lisa inferiormente, algo escariosa hacia el extremo, 5–7-nerviada, oscuramente así; los antecios lateralmente comprimidos. Palea 2-nerviada, más corta que la glumela o del mismo largo, 2.6–3.1 mm. de largo, por 0.5 mm. entre los nervios; estos escariosos o casi ciliados hacia el vértice, el ápice entero. El segundo antecio 2.3 mm., igual en estructura al inferior, con la palea del mismo largo que la glumela. Estambres 3, con los filamentos ¼ más cortos que las anteras, éstas 1.7–2.2 mm. de largo. El callo robusto, redondeado, amarillento, estrangulado hacia la base de la glumela, bordeado por pelos blancos, tiesos, cortos de no más de 0.5 mm. Ovario 0.5 mm., angosto hacia la base, con el estigma poco plumoso, 1.8 mm.; estilos cortos y aplanados, naciendo separados. Caryopsis hirsuto en el ápice, 1.2 mm. y 0.4 mm. de ancho, subtriangular, de surco más o menos profundo; hilio lanceolado-linear, negruzco. Lodículos bilobulados, con uno de ellos más corto y colocado lateralmente, 1 mm. de largo, y 0.3 de ancho.

[4] *Panicum oligostachium* (según descripción) Fr. Vidal Gormaz, Maullín en 1874.

Panicum oligostachium Steudel, Syn. Pl. Gram. **1**: 97. 1854.

Hemos estudiado un ejemplar del Herbario Steudel, Museo de París, que lleva en la etiqueta el nombre manuscrito por el autor, seguido de: "prope Conception, Chili, legit Urville"; se trata de un espécimen pobre, obtenido por Mrs. Chase en 1935.

Isotipo de la especie, en el Herbario de Caen, Francia (CN); la etiqueta dice: "Chauvin 1851, Hb. Urville, Chile,"[5] que le suponemos como tal. No lleva indicaciones manuscritas por el autor. Se trata de un ejemplar pequeño, de más o menos 12 cm. de altura. Chase, 1935.

Ramificaciones de la panoja verticiladas, con 2–4 ramificaciones escabras; la espiguilla de dos antecios, 3.4 mm. de largo, de pedicelo escarioso; gluma inferior 3.7 mm. y 0.5 mm. de ancho, 1-nerviada, escariosa en la mitad superior y borde finamente aserrado; gluma superior 3-nerviada, escariosa como la primera de 3.5 mm., y 0.8 mm. de ancho; antecio de 3 mm. por 0.6 mm. de ancho, coronado por pelos en su base, lanceolado-oblongo. Glumela levemente 7-nerviada, 0.7 mm. de ancho, escariosa; palea de 2 mm. de largo y 0.5 mm. de ancho, 2-nerviada, francamente escarioso-pubescente en los bordes. El segundo antecio 1.8 mm., 0.5 mm. de ancho; la proporción entre palea y glumela es la misma como en el primer antecio. Anteras 0.4 mm. de largo, con el filamento muy corto. Ovario 0.4 mm. de largo, escasamente pubescente. El segundo antecio en este espécimen es más pequeño que en el material observado anteriormente, y la palea del primer antecio difiere por su longitud notablemente más corta.

Agrostis ? asperula Phil. Linnaea **29**: 89. 1857–58.

Desconocemos dónde pueda encontrarse el tipo de Philippi, pero su descripción concuerda en todos sus caracteres con *Relchela*. El autor indica su posición dudosa en *Agrostis*. Pilger (19) dice haber observado un espécimen determinado por Philippi como tal, pero cuyas espiguillas llevan un solo antecio. El ejemplar citado más adelante, también determinado por Philippi, concuerda más con su descripción (NY). En el Museo de Santiago (SGO), Espinosa[6] nos da cuenta que ejemplares bajo esta especie existen dos: uno de Puyehue, Prov. Valdivia, y otro de San Juan, Mirador, Enero de 1865, que difieren de la localidad original del tipo.

Agrostis limonias Phil. Linnaea **33**: 287. 1864–65.

El tipo de esta especie se encuentra conservado en el Herbario Hackel,

[5]Chauvin fué el médico del barco en la Expedición comandada por D'Urville. Probablemente los especímenes de este último fueron colectados por Chauvin.

[6]Carta fecha 29 de Enero, 1940.

Museo de Viena (W). Nos ha sido posible estudiar un fragmento de él y una fotografía del mismo ejemplar. La etiqueta dice: Pantanos [Manuscrito de Philippi] *Agrostis limonias* Ph. Valdivia [Manuscrito de Reiche]. Además no. 150, que corresponde al envío de material efectuado por el Museo Nacional de Santiago al Prof. E. Hackel. El espécimen se compone de un solo culmo quebrado, y sus vainas alcanzan casi hasta la altura de la panícula; las espiguillas de color amarillo claro. La gluma inferior de 3.5 mm., la superior casi del mismo largo. Antecio de 2.8 mm., visiblemente coronado por un círculo de pelos tiesos. La glumela difiere un tanto del ejemplar de Lechler por tener la superficie de su mitad inferior casi completamente lisa y brillante, de color amarillo pálido. Anteras 1–1.2 mm., flavas. Palea 2.5 mm. por 0.4 mm. de ancho, escariosa hacia arriba, los nervios casi paralelos en la mitad. La raquilla pubescente, de 2 mm. de largo.

Agrostis ?? corralensis Phil. Linnaea **33:** 286. 1864–65.

Hemos estudiado fotografía y fragmento de un ejemplar, conservado en el Herbario de Viena (W). Ejemplares de esta especie no se encuentran representados en Santiago. La etiqueta dice: "Agrostis corralensis Ph. no. 161,[7] Valdivia" [en manuscrito de Reiche]. La fotografía muestra un espécimen de un solo culmo, desprovisto de la parte basal. Las vainas alcanzando hasta el nacimiento de la panícula; las láminas son anchas, planas, lanceoladas, acuminadas, notablemente estriadas. En general este material aparece más robusto que los otros especímenes estudiados. Espiguillas de 2 antecios, de 4 mm. de largo; el primer antecio 3.5 mm. por 1.6 mm. de ancho, 3-nerviado, muy oscuramente 5-nerviado, escarioso, de ápice angostamente obtuso; palea 2-nerviada, escariosa en sus ¾ superiores, 3 mm. de largo y raquilla 0.8 mm. de largo. El segundo antecio 3 mm., escarioso, raquilla 2 mm. de largo, pubescente. La raquilla del primer antecio es ensanchada en su término y está provista de abundantes pelos blancos, que la sobrepasan en su mismo largo. Anteras del primero 1.5–2 mm.; ovario 0.5 mm., no desarrollado, pubescente; lodículos 1 mm. de largo, 0.3 mm. de ancho.

Las dimensiones anotadas en las descripciones son las correspondientes a material observado en seco. Los órganos florales (sexuales) y lodículos fueron observados después de remojar los antecios durante 3 a 5 minutos en agua caliente, agregando 2 o 3 gotas de glicerina. Las abreviaciones empleadas para los diferentes herbarios son aquellas publicadas por *Chronica Botanica* (**5:** 142–150. 1939), de acuerdo con la standarización que se quiere establecer en este sentido.

[7]Numeración correspondiente al material enviado a Viena.

Ciertos ejemplares presentaban pústulas negruzcas sobre las láminas, que corresponden al patógeno *Phyllachora graminis* (Pers.) Fkl., de la familia Dothideaceae, indicando con ello un nuevo mesonero para este hongo.[8]

La comparación del tipo de *Agrostis sesquiflora* Desv.,[9] conservado en el Museo de París, y del cual hemos observado fragmentos, nos lleva a la conclusión que la combinación nueva de Pilger, establecida recientemente, *Briza* (§ *Relchela*) *sesquiflora* (Desv.) Pilger, no tiene base. Desvaux (10) al término de la diagnosis dice que el rudimento del pedicelo de una segunda flor es siempre más corto que la cuarta parte de la palleta inferior, algunas veces pestañado en el vértice, y pocas líneas antes dice que las espiguillas son ovales, uniflores, presentando generalmente un rudimento del pedicelo de segunda flor.

La primera de estas citaciones de la diagnosis dada por Desvaux ha servido seguramente de base para que la interpretación del rudimento de segunda flor quede relacionada a nuestra *Relchela panicoides*. Sin embargo, *Agrostis sesquiflora* Desv. está afortunadamente muy bien definido e ilustrado en la Flora de Claudio Gay, y evidentemente nada existe de común con *Relchela*.[10] *A. sesquiflora* alcanza de 30–35 cm.;[11] láminas 5–7.5 cm. de largo, 1.5–2 mm. de ancho, vainas lisas; panojas 5–7.5 cm.; espiguillas estrictamente unifloras con un rudimento de raquilla angosta, cilíndrica, que alcanza a la cuarta parte de la glumela; glumas uninerviadas, 2–2.5 mm.; glumela 1, 5-nerviada, membranosa, delgada, 2 mm. de largo; palea de la misma consistencia que la glumela, 2-nerviada, más corta y truncada en el vértice; callo glabro; lodículos oval-alargados, enteros; anteras 0.4–0.5 mm. de largo; ovario ovoideo con los estilos naciendo casi juntos; caryopsis cilindroideo, de 1 mm., glabro, de hilio punctiforme.

El rudimento de segunda flor de las especies de *Agrostis* ha sido también observado en algunas especies norteamericanas, e Hitchcock (13) lo expresa como caracter fundamental en su clave.

Por otro lado — y esto hasta donde nos ha sido posible observar —

[8]Determinación del Dr. Annie E. Jenkins, del Departamento de Agricultura, Washington, D. C., y comprobado por el Dr. E. R. Orton, especialista en el género.

[9]El tipo de Desvaux se compone de 4 especímenes y 4 culmos extras, una base mostrando un rizoma delgado, rastrero, 2.5 cm. de largo; los culmos de 18–30 cm. de altura, hojosos en la base láminas planas, flexibles; las panículas de 4.5–7 cm., todas angostas pero sueltas. La etiqueta tiene anotado: "Desv. 3, *Agrostis sesquiflora* nob. Em. Desvx." [manuscrito del autor]. En etiqueta de Gay: "185 m.ch.antuco Chili (Province de....)."

[10]Serán considerados sinónimos de esta especie: *Briza sesquiflora* (Desv.) Pilger y *Deyeuxia sesquiflora* (Desv.) Benth. & Hook. f. ex Jackson.

[11]*Claudio Joseph 4229*, Yumbel, Jan. 1928 (US. no. 1423582); Herb. R. A. Philippi, s.n., Baños de Chillán, Jan. 1877 (US. no. 556343).

Agrostis sesquiflora parece ser una especie que habita la alta cordillera andina. Nuestra especie, en cambio, queda localizada principalmente en el valle central y los cordones de la cordillera de la costa.

MATERIAL ESTUDIADO.

VALPARAÍSO: *Otto Buchtien s.n.,* Valparaíso, Agosto, 1894 (US. no. 1099593). CURICÓ: *Claudio Joseph 4269,* Curicó, Enero, 1928 (US. no. 1423606); *Claudio Joseph 4254,* Curicó, Enero, 1928 (US. no. 1423597). CONCEPCIÓN: *Claudio Joseph 5714,* Concepción, Nov. 1927 (US. no. 1423625); *Claudio Joseph 4602,* Concepción, San Pedro, Oct. 1926 (US. no. 1299006); *Claudio Joseph 182,* Concepción, Oct. 1925 (US. no. 1258854); *F. W. Neger s.n.,* Concepción (US. no. 1129015); *Claudio Joseph 4212,* Tomé, Nov. 1929 (US. no. 1283793); *Claudio Joseph 5713,* Concepción, Nov. 1927 (US. no. 1423624). MAULE: *R. A. Philippi 559,* Prov. Maule (US. no. 1761968). ÑUBLE: *E. W. D. & M. M. Holway 277,* Recinto, Jan. 1920. CAUTÍN: *Claudio Joseph 4664,* Temuco, Dec. 1926 (US. no. 1299005); *E. W. D. & M. M. Holway 167,* Temuco, Nov. 1919. VALDIVIA: *Otto Buchtien, s.n.,* Valdivia, Sept. 1905 (US. no. 1099592); *H. Gunckel 2812,* Cerros del Bolsón, Corral, Dec. 1931 (US. no. 1538160); *H. Gunckel 1512,* Amargos, Feb. 1930 (US. no. 1502456); *Claudio Joseph 2644,* Panguipulli, Enero, 1924 (US. no. 1198570). LLANQUIHUE: *Fr. Vidal Gormaz s.n.,* Maullín (SGO. no. 226). SIN LOCALIDAD: *R. A. Philippi* (SGO. no. 589) (US. no. 556334); *R. A. Philippi* (SGO. no. 20) (US. no. 1761969); *Philippi,* Chile (NY).

Agradecimientos: El trabajo fué realizado bajo la dirección de Dr. Agnes Chase, a cargo del Herbario de Gramíneas del Museo Nacional, en Washington, y a quien expresamos nuestro más sincero aprecio y reconocimiento por su inteligente ayuda y crítica. A Dr. Jason R. Swallen, del Departamento de Agricultura, por su crítica en la discusión de la posición sistemática del género, los hacemos extensivos.

SUMMARY

(1) The genus *Relchela* Steudel has been ignored or misinterpreted since its erection, and its only species, *Relchela panicoides* Steudel, has been considered an anomalous species of *Agrostis, Calamagrostis,* and more recently as the type-species of a new section of *Briza.*

(2) Because of its well-defined floral characters, *Relchela* has a definite phylogenetic and taxonomic status and belongs to the tribe Festuceae, subtribe Festucinae.

(3) *Agrostis sesquiflora* Desv. and *Relchela panicoides* Steudel being

compared with *Briza sesquiflora* (Desv.) Pilger, based on the former, Pilger's combination is invalid.

(4) A new diagnosis is given for critical type-material and isotypes, and a new synonymy as well.

(5) Spikelets formed by a single floret are interpreted as cleistogamous elements.

(6) The species is a host to *Phyllachora graminis* (Pers.) Fkl.

BIBLIOGRAFIA

1. Arber, Agnes (1934). Gramineae. A study of Cereal, Bamboo, and Grass. Cambridge.
2. Bentham, G. (1881). Notes on Gramineae. Jour. Linn. Soc. Bot. **19**: 14–134.
3. ——— and J. D. Hooker (1883). Genera Plantarum 3 (2). London.
4. Bews, J. W. (1929). The World's Grasses. London.
5. Chase, Agnes (1908). Notes on cleistogamy of grasses. Bot. Gaz. **45**: 135–136.
6. ——— (1911). Notes on Genera of Paniceae. IV. Proc. Biol. Soc. Wash. **24**: 103–159.
7. ——— (1918). Axillary cleistogenes in some American grasses. Am. Jour. Bot. **5**: 254–258.
8. ——— (1924). Aciachne, a cleistogamous grass of the high Andes. Jour. Wash. Acad. Sci. **14**: 364–366.
9. Dalla Torre, C. G. & H. Harms (1900–07). Genera Siphonogamarum. Lipsiae.
10. Desvaux, E. (1853). Gramineas, in Gay, Historia Física y Política de Chile, Botánica **6**: 233–469; Atlas Botánica, Fanerógam. *lám. 74–83*.
11. Hackel, E. (1890). The true grasses. New York.
12. ——— (1937). Sulla cleistogamia nelle Graminacee. Revis. Arg. Agron. **4**: 1–26.
13. Hitchcock, A. S. (1935). Manual of the grasses of the United States. U. S. Dept. Agr. Misc. Publ. 200. Washington.
14. Hubbard, C. E. (1934). Gramineae, in Hutchinson, J. The families of flowering plants, **2**: 199–229. London.
15. Jackson, B. D. (1895). Index Kewensis **1**: 740. London.
16. Parodi, L. R. (1920). Notas sobre las especies de Briza de la flora Argentina. Revis. Fac. Agron. y Vet. [Univ. Buenos Aires] **3**: 113–138.
17. Philippi, R. A. (1857–58). Plantarum novarum Chilensium. Linnaea **29**: 1–110.
18. ——— (1864–65). Plantarum novarum Chilensium. Linnaea **33**: 1–308.
19. Pilger, R. (1938). Über die systematische Stellung und Nomenklatur einiger Gramineen-Gattungen. Repert. Sp. Nov. **45**: 1–8.

20. STEUDEL, E. G. (1854–55). Synopsis plantarum graminearum. Stuttgartiae.

EXPLICACION DE LA LAMINA

Fig. A. Habitat, Vidal Gormaz, año 1874. × 1.

Fig. 1. Espiguilla mostrando los dos antecios y la raquilla pubescente.

Fig. 2. Primer antecio.

Fig. 3. Segundo antecio y prolongación de la raquilla.

Fig. 4. Palea vista ventralmente.

Fig. 5. La misma desde el dorso. [Dibujados del tipo, × 20].

Fig. 6. Caryopsis normal × 40 (*Joseph 5819*).

Fig. 7. Caryopsis de elementos cleistogámicos × 40 (Tipo).

Fig. 8. Organos sexuales × 20 (Isotipo, Hb. Pittier & Durand).

Fig. 9. Lodículos de los mismos × 20.

Fig. 10. Mapa mostrando la distribución geográfica en la parte centro-sur de Chile.

WASHINGTON, D. C.

RELCHELA PANICOIDES Steudel

CHROMOSOME BEHAVIOR IN CATALPA HYBRIDA SPAETH

E. Chalmers Smith*

According to Seward (1931), the genus *Catalpa* Scop. of the Bignoniaceae is represented in fossil deposits in what was an Oligocene river estuary on the Isle of Wight. There is reason to believe that the genus, in common with other genera of that time, was more widely distributed then than now.

Catalpa is now represented by about ten species in North America, the West Indies and eastern Asia (Rehder, 1940). *Catalpa ovata* Don is native to China and is a cultivated tree in Japan. *Catalpa bignonioides* Walt. and *C. speciosa* Warder are both North American species. These three are the common cultivated catalpas of this region.

A natural hybrid appeared when *C. ovata* was introduced into this country in 1849 and was planted near the native species in Indiana (Sargent, 1889). This hybrid was thought to be the cross *C. ovata* × *C. bignonioides* and is known as *Catalpa hybrida* Spaeth (Teas' Hybrid Catalpa). According to Sargent this tree is more vigorous and of more rapid growth than either the American or the Chinese parent. It sets good crops of seed and shows segregation in the F_2 generation.

In 1911 Dr. E. M. East made the reciprocal cross, *C. bignonioides* × *C. ovata* at the Connecticut Experiment Station. This cross resulted in a numerous progeny identical with the natural hybrid, very vigorous, and five to ten times more productive in amount of seed produced than either parent. These seeds were well developed and fertile. A sample tested in the incubator gave 51% viability (Jones and Filley, 1920).

The fact that this species hybrid is fertile and segregates in the second generation indicates that the parents probably have the same chromosome number and that their chromosomes are similar in structure. The haploid chromosome number of *C. syringaefolia* Sims (= *C. bignonioides* Walt.) has been reported by Scheu to be = 20 (Tischler, 1936). Aceto-carmine smears of pollen mother cells from *C. ovata, C. bignonioides,* and *C. hybrida* clearly show the haploid number of chromosomes to be 20. In addition, smears of seedling root tips of *C. speciosa* show the diploid number in this species to be 40. Up to this time few chromosome numbers have been determined in this large

*Maria Moors Cabot Foundation Fellow.

family. The haploid chromosome number of 20 seems to be common to one other genus, *Campsis* Lour. (Sax, 1933).

The chromosomes of *C. ovata* and *C. bignonioides* pair regularly and show no irregularities in any stage of the meiotic divisions or microspore formation. Both species are highly fertile, showing from 90–95% morphologically good pollen in counts of 2000 pollen grains. *Catalpa hybrida* exhibits a similar behavior. The chromosomes pair regularly at the first meiotic division and there is no evidence of lagging chromosomes or inversion bridges at either the first or second meiotic divisions. Neither is there any indication of polyspory. The fertility of this hybrid corresponds to that of the parent species. These conclusions are based upon the examination of twenty-five metaphase and anaphase plates of each of the meiotic divisions for the species concerned.

The species *C. ovata* of eastern Asia and *C. bignonioides* of North America have evidently been isolated for a long period of time, and yet their chromosomes seem to have undergone no fundamental change in structure. There seems some reason to believe that a similar condition exists in the case of *C. ovata* and *C. speciosa,* for a cross made between these two species in the Arnold Arboretum in 1940 has set a quantity of well developed seed.

Among the reports of fertile F_1 hybrids between geographically isolated species which have appeared in the literature are those of several hybrids between woody species. *Platanus acerifolia* (Ait.) Willd., a hybrid between *P. occidentalis* L. and *P. orientalis* L., shows complete chromosome pairing and segregation at meiosis accompanied by high fertility (Sax, 1933). *Larix eurolepis* Henry, the hybrid *L. leptolepis* (Sieb. and Zucc.) Gord. (= *L. Kaempferi* Sarg.) × *L. decidua* Mill. represents a cross betweeen a Japanese and an European species. A study of meiosis in this hybrid (Sax, 1932) shows almost complete pairing of the chromosomes with about 9% morphologically imperfect pollen as opposed to complete pairing and 2–3% morphologically imperfect pollen found in the parent species. In addition the average chiasma frequency is approximately the same in both parents and the hybrid. *Campsis Tagliabuana* (Vis.) Rehd., a hybrid between an Asiatic and a North American species, shows complete chromosome pairing but is partially sterile.

LITERATURE CITED

Jones, D. F. & W. O. Filley (1920). Teas' Hybrid Catalpa. Jour. Hered. **11**: 1–9.

Rehder, A. (1940). Manual of cultivated trees and shrubs, Ed. 2. Macmillan Co., N. Y.

Sargent, C. S. (1889). A hybrid Catalpa. Garden and Forest **2**: 303–305.

Sax, H. J. (1932). Chromosome pairing in Larix species. Jour. Arnold Arb. **13**: 368–373.

Sax, K. (1933). Species hybrids in Platanus and Campsis. Jour. Arnold Arb. **14**: 274–278.

Seward, A. C. (1931). Plant life through the ages. Macmillan Co., N. Y.

Tischler, G. (1936). Pflanzliche Chromosomen — Zahlen. Tabulae Biologicae **12**: 57–115.

Biological Laboratories,
Harvard University.

A NOTE ON THE DATES OF PUBLICATION OF WIGHT'S "ICONES PLANTARUM INDIAE ORIENTALIS."

E. D. MERRILL

THE basic information on the dates of issue of the various parts of this important work, consisting as it does of 2101 plates and accompanying descriptive text, is that supplied by Wight himself.* In the preface to the last volume, dated January 20, 1853, he states that the last part was issued in March, 1853. Here he gives the year and the month of issue of most of the parts, and his data, which are frequently overlooked except by experienced bibliographers, are repeated below, for even Pritzel, "Thesaurus" ed. 2, 346, no. 10246. 1877, gives only the inclusive dates 1840–56 for the six volumes, although in the first edition of that work, 1851, p. 322, no. 11222, he does give the dates of publication of the first three volumes as **1**(1838–40), **2**(1842), and **3**(1843–47). Wight's data are repeated below, verbatim:

"Vol. I.

Nos. 2, 3, (Plates 21–60)	Sept. 1838.
Nos. 4, 5, (61–100)	Nov. 1838.
Nos. 6, 7, 8, (101–161)	June 1839.
No. 9, (162–181)	Aug. 1839.
No. 10, (182–201)	Sept. 1839.
Nos. 11, 12, (202–241)	Nov. 1839.
Nos. 13, 14, (242–279)	Feb. 1840.
Nos. 15, 16, (280–318)	May 1840.
Vol. II.	
(319–736)	1840–1843.
Vol. III.	
Parts I. II. III. (737–1046)	1843 to Nov. 1845.
Part IV. (1047–1162)	Sept. 1846.
Vol. IV.	
Part I. (1163–1282)	Jan. 1848.
Part II. (1283–1403)	Aug. 1848.
Part III. (1404–1501)	Apr. 1849.
Part IV. (1502–1621)	May 1850.
Vol. V.	
Part I. Orchideae, (1622–1762)	May 1851.
Part II. (1763–1920)	Jan. 1852.
Vol. VI.	
(1921–2101)	Mar. 1853."

*WIGHT, R. Icones plantarum Indiae Orientalis 6: viii. 1853.

The record is complete except for volume one, number one (plates 1–20), volume two (parts 1–4, plates 319–736), and volume three (parts 1–3, plates 737–1046). A fascicle cover for volume 1, no. 1, is dated 1838, and in his prospectus Wight states that no. 1 was to appear in July of that year; thus 1838 can safely be accepted as the date of issue of this part.

It is worthy of note that the first twenty plates forming number one bear the numbers 35, 73, 160, 171, 176, 178, 189, 197, 198, 198[bis], 198[ter], 205, 334, 339, 341, 342, 396, 467, 513, and 723. These figures apply to the numbers of the species as described in Wight and Arnott's "Prodromus" published in 1834. These plates, in sequence, should be numbered 1 to 20, for while Wight added the forms $\frac{1}{35}$, $\frac{2}{73}$, $\frac{3}{160}$, etc., in his published explanations of the plates and brief descriptions, he did not commence to print these fractional forms on the plates until number two appeared. This system of numbering is obscure until one realizes that where the fractional form of numbering appears on the plates and in the text, the numerator represents the sequence of plate numbers for the "Icones" (this to be cited), and the denominator is the species number in Wight and Arnott's "Prodromus florae Indiae Orientalis" (1834).

After number one appeared, Nathaniel Wallich, then Superintendent of the Botanic Garden at Calcutta, placed at Wight's disposal the unpublished drawings prepared under the direction of William Roxburgh, and now preserved in the library of that institution. The use of these Roxburgh drawings is explained by Wight in a notice issued with the second number of the "Icones"; these illustrations, as reproduced by Wight, all bear the legend "Roxburghianae." This is mentioned to emphasize the importance of these particular illustrations, for they graphically represent numerous species actually described by Roxburgh in his "Flora Indica" ed. 1, **1**(1820), **2**(1824), and ed. 2, **1–3**(1832).

Wight's original plan of publication was to issue twenty plates, with descriptive text, as individual numbers, and this plan was approximately followed for those parts forming volume one. Beginning with volume two this plan was changed to one involving fewer and larger parts, the four forming volume two containing from 98 to 116 plates each, this system being continued to the end of the work. In reference to volume two, I have no information as to the dates of issue other than Wight's own statement (Icones **6**: viii. 1853) that of volume two, plates 319–736 were issued from 1840 to 1843; the title page date is 1843. As plates 319–416 form part one, we can rather safely assume that this part was issued in 1840. Part four includes plates 632 to 736 and clearly appeared in 1843. This leaves plates 417 to 631, forming parts two and three, for

which more definite dates of issue are as yet unknown, other than the inclusive period 1840–43, although it seems probable that they may have been issued in 1841–42.

For volume three it is now possible to add some supplementary information regarding the dates of issue from a fascicle cover, and its accompanying notice, recently received at the Arnold Arboretum. Wight states (Icones 6: viii. 1853) that parts one to three of this volume appeared from 1843 to November 1845. The fascicle cover of number one of volume three bears the printed date 1843, but it was clearly not issued until 1844. In the notice accompanying this part, in explaining the delay in the issue of his "Illustrations of Indian Botany," Wight states regarding the latter: "Immediately on publication of the last part [of the "Illustrations"] published (Part 1, Vol. 2) he was under the necessity of packing up the whole of his collections preparatory to leaving Madras and *up to the present hour, (May 1, 1844)* [italics mine] the greater part of them are unavoidably still in the packing cases." Thus part one of volume three of the "Icones" could not have been issued *before May, 1844*. As the list on the inside of the back cover of the fascicle cover included plates 737 to 815, we can safely assume that the year of publication of these was 1844 (not 1843), and probably in May of that year. For volume three, part three, plates 618 to 930, and the text of plates 931 and 932, repeated in volume three, part two, no additional data are available other than that the part was issued in 1844–45. Part three, including plates 931 to 1046, appeared in November, 1845 (Wight's own statement), and the remainder of the volume, plates 1047–1162, in September, 1846* (again Wight's own statement).

Summarizing we can thus narrow the dates of publication of the parts discussed, as follows:

Vol. 1, No. 1, pl. 1–20	(July?)	1838
Vol. 2, Part 1, pl. 319–416		1840
Part 2, pl. 417–514		1840–43 (probably 1841)
Part 3, pl. 515–631		1840–43 (probably 1842)
Part 4, pl. 632–736		1843
Vol. 3, Part 1, pl. 737–815	(May?)	1844
Part 2, pl. 816–930		1844–45
Part 3, pl. 931–1046	(Nov.)	1845
Part 4, pl. 1047–1162	(Sept.)	1846

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

*PRITZEL, G. A. Thesaurus literaturae botanicae ed. 1, 322, no. 11222, 1851, states that volume three, parts 1 to 4, plates 737–1162, appeared in 1843–47. It has been shown above that the first part, plates 737–815, could not have appeared before May, 1844, but the last part, plates 1047–1162, may not have been issued until 1847.

LEDEBOUR'S "FLORA ROSSICA," "ICONES PLANTARUM NOVARUM," AND "FLORA ALTAICA," WITH A NOTE ON PALLAS' "FLORA ROSSICA."

WILLIAM T. STEARN

AMONG the many German naturalists who labored under the Tzars and Tzarinas of Russia to make known the vegetation and fauna of that vast realm, Carl Friedrich von LEDEBOUR (1785–1851) holds an honored place for being the first man to complete a comprehensive flora, one with detailed descriptions and synonymy, covering northern Asia, the Caucasus, and Alaska, as well as European Russia. Such a work, with colored folio plates and on too grand a scale ever to be finished, was begun by Catherine the Great's favorite, Peter Simon PALLAS (1741–1811), but only two parts of his *Flora Rossica* were published. LEDEBOUR'S *Flora Rossica sive Enumeratio Plantarum in totius Imperii Rossici Provinciis Europaeis, Asiaticis et Americanis*[1] *hucusque observatarum* is in more modest but more practical octavo format, without illustrations but including a map. Its publication began at Stuttgart in 1841 and ended in 1853, two years after Ledebour's death. Alexander von BUNGE (1803–1890) wrote the account of *Pedicularis;* Eduard FENZL (1808–1879) the account of Alsineae, Amarantaceae, *Gypsophila,* Paronychieae, Phytolaccaceae, Salsolaceae, Scleranthеae; August H. R. GRISEBACH (1814–1879) the account of Gramineae; Ernst H. F. MEYER (1791–1858) the account of Juncaceae; Ludolph Christian TREVIRANUS (1799–1864) the account of Carex. According to Trautvetter, it includes 6522 species (5398 Dicotyledons, 1040 Monocotyledons, 84 Cryptogams). Few botanists are aware that this work, like many other floras, came out in parts; hence citations from it are not always correctly dated. The contents of the parts of Ledebour's *Flora Rossica* and their probable dates of issue as revealed by contemporary notices, notably those in the weekly *Allgemeine Bibliographie für Deutschland* (Leipzig), *Botanische Zeitung* (Berlin), J. C. Hinrichs, *Verzeichniss neuer Bücher* (Leipzig), and the *Leipziger Repertorium der deutschen und ausländischen Literatur, herausgegeben von E. G. Gersdorf* (Leipzig), are as follows:

[1] "America Rossica," i. e. Alaska, did not become United States territory until 1867.

VOLUME 1

	Contents	*Date*	*Authority*
Fasc. 1.	text pp. 1–240, Conspectus pp. 1–8, Praefatio etc. pp. iii–xvi	1841 (late)	Hinrichs, Verz. Juli–Dec. **1841**: 148; Gersdorf, Rep. **32**: 234 (1842).
Fasc. 2.	text pp. 241–480, Conspectus pp. 9–16	1842 (probably October)	Baillière invoice to British Museum dated 18 Nov. 1842; Flora **25**, II: 765 (Dec. 1842); Hinrichs, Verz. Juli–Dec. **1842**: 145; Leipz. Rep. **1**, I: 333 (Feb. 1843); Archiv. f. Naturg. **8**, II: 416 (1843).
Fasc. 3.	text pp. 481–790, Conspectus pp. 17–22	1843 (probably March)	Allg. Bibl. **1843**: 116 (*27* April 1843); Bot. Zeit. **1**: 402 (June 1843); Hinrichs, Verz. Jan.–Juni **1843**: 115.

VOLUME 2

Fasc. 4.	text pp. 1–204	1843 (probably September)	Bot. Zeit. **2**: 730 (18 Oct. 1843); Allg. Bibl. **1843**: 348 (16 Nov. 1843); Hinrichs, Verz. Juli–Dec. **1843**: 127; Leipz. Rep. **1**, IV: 456 (Dec. 1843).
Fasc. 5.	text pp. 205–462	1844 (probably July)	Allg. Bibl. **1844**: 252 (15 Aug. 1844); Bot. Zeit. **2**: 730 (Oct. 1844); Hinrichs, Verz. Juli–Dec. **1844**: 144; Archiv. f. Naturg. **10**, II: 378 (1844).
Fasc. 6.	text pp. 463–718, Conspectus pp. 1–13	1845 (probably August)	Bot. Zeit. **3**: 617 (12 Sept. 1845); Allg. Bibl. **1845**: 308 (2 Oct. 1845); Leipz. Rep. **3**, IV: 195 (Oct. 1845); Hinrichs, Verz. Juli–Dec. **1845**: 139.
Fasc. 7.	text pp. 719–937, Conspectus pars 2 pp. 1–12, Fl. Ross. Fontes pp. i–vi.	1846 (probably August)	Bot. Zeit. **4**: 621 (4 Sept. 1846); Allg. Bibl. **1846**: 300 (17 Sept. 1846); Leipz. Rep. **4**, IV: 76 (Oct. 1846); Hinrichs, Verz. Juli–Dec. **1846**: 136.

VOLUME 3, part 1

Contents	*Date*	*Authority*
Fasc. 8. text pp. 1–256	1847 (probably October)	Allg. Bibl. **1847**: 364 (4 Nov. 1847); Bot. Zeit. **5**: 871 (Dec. 1847); Hinrichs, Verz. Juli–Dec. **1847**: 163.
Fasc. 9. text pp. 257–492, Conspectus pp. 1–13	1849 (probably June)	Allg. Bibl. **1849**: 220 (12 July 1849); Leipz. Rep. **7**, III: 238 (July 1849); Hinrichs, Verz. Juli–Dec. **1849**: 130; Wikström, Årsberätt. **1849**: 125 (1852).

VOLUME 3, part 2

Fasc. 10. text pp. 493–684, Conspectus pp. 1–4	1850 (probably November)	Allg. Bibl. **1850**: 461 (5 Dec. 1850); Wikström, Årsberätt. **1850**: 139 (1854); Leipz. Rep. **9**, I: 113 (Jan. 1851); Hinrichs, Verz. Jan.–Juni **1851**: 144; Bot. Zeit. **9**: 199 (March 1851).
Fasc. 11. text pp. 685–863, Conspectus pp. 5–8	1851 (probably December)	Allg. Bibl. **1852**: 9 (8 Jan. 1852); Hinrichs, Verz. Jan.–Juni **1852**: 149; Bot. Zeit. **10**: 134 (Feb. 1852); Wikström, Års-berätt. **1851**: 103 (1855).

VOLUME 4

Fasc. 12. text pp. 1–240	1852 (probably April)	Allg. Bibl. **1852**: 160 (20 May 1852); Hinrichs, Verz. Jan.–Juni **1852**: 149; Bot. Zeit. **10**: 723 (Oct. 1852); Leipz. Rep. **10**, III: 52 (1852); Wikström, Årsberätt. **1851**: 111 (1855).
Fasc. 13. text pp. 241–464	1852 (probably September)	Allg. Bibl. **1852**: 379 (21 Oct. 1852); Hinrichs, Verz. Juli–Dec. **1852**: 151; Wikström, Års-berätt. **1851**: 111 (1855); Leipz. Rep. **11**, I: 120 (1853).
Fasc. 14. text pp. 465–741, Conspectus pp. 1–16	1853 (probably June)	Allg. Bibl. **1853**: 229 (14 July 1853); Bot. Zeit. **11**: 630 (Sept. 1853); Hinrichs, Verz. Juli–Dec. **1853**: 173; Leipz. Rep. **11**, IV: 52 (1853).

Ledebour's *Icones Plantarum novarum vel imperfecte cognitarum Floram Rossicam, imprimis Altaicam, illustrantes* (5 vols., folio, with colored plates; Riga etc.) was also published in parts. A copy in the Lindley Library with the original wrappers preserved supplies the following data:

Vol. 1	fasc. 1,	tt.	1–50	} 1829	
" 1	" 2,	"	51–100		
" 2	" 1,	"	101–150	} 1830	
" 2	" 2,	"	151–200		
" 3	" 1,	"	201–250	— 1831	
" 3	" 2,	"	251–300	— 1832	
" 4	" 1,	"	301–350	} 1833	
" 4	" 2,	"	351–400		
" 5	" 1,	"	401–450	} 1834	
" 5	" 2,	"	451–500		

Ledebour's *Flora Altaica* (4 vols. and index, octavo: Berlin) provides detailed text to the *Icones*. This work, which was written in collaboration with his one-time pupils, Carl Anton MEYER (1795–1855) and Alexander von BUNGE (1803–1890), is based on an expedition to the Little (or Siberian) Altai region of Central Asia made by the three in 1826. Their travels extended from Dorpat to Barnaul, Zmeyeva (Schlangenberg), Krasnoyarsk, the source of the river Charysh (Tscharysh) etc., the Riddersk mine and about 120 miles eastward over the Altai mountains. For a detailed account, see their *Reise durch das Altai-Gebirge und die Soongorische Kirgisen-Steppe* (2 vols., octavo, and atlas of plates, quarto; Berlin, 1829–30). The *Flora Altaica* was not published in parts but a whole volume at a time, as follows:

Vol. 1, pp. xxiv	+ 440	... 1829	(probably second half)
" 2, pp. xvi	+ 464	... 1830	" " "
" 3, pp. viii	+ 368	... 1831	" " "
" 4, pp. xiv	+ 336	... 1833	" " "
" Index, pp. xcvi		 1833	(thus dated but probably 1834, cf. Hinrichs, Verz. Juli–Dec. **1834**: 121)

Ledebour was born in Pomerania at Greifswald in 1786 (fide Flora **34**: 416. 1851) or at Stralsund on 8th July 1786 (fide Pritzel, who is more likely to be correct). In his nineteenth year he was appointed associate professor ("ausserordentlicher Professor") of Botany and

director of the botanic garden at Greifswald. From here in 1810 or 1811, after seeking information about Russia from Pallas, who was then living in Berlin, Ledebour moved to Dorpat as professor of botany, mineralogy, and zoology; much of the next twenty-five years he devoted to the botanical exploration of Russia from the Baltic to the Black Sea and east to the Altai mountains. To prepare the better his *Flora Rossica* he retired from Dorpat in 1836, his former pupil Bunge succeeding him as professor, and returned to Germany, living first at Heidelberg, then at Munich, where he died on 4th July 1851, having completed the text a few months before his death.

P. S. Pallas, *Flora Rossica seu Stirpium Imperii Rossici per Europam et Asiam indigenarum Descriptiones et Icones,* Vol. 1 pars 1 consisting of pp. viii + 80, tt. 1–8, 8B, 9–50 (1784); pars 2 consisting of pp. 114, tt. 50 (1788); extra plates 1–25 (1831); cf. B. D. Jackson in Jour. Bot. **38:** 189 (1900).

Unfortunately both parts lack indices; the following are the genera (most of them nowadays divided into smaller genera) included:

Acer 1: 8, Amygdalus 1: 12, Andromeda 2: 53, Arbutus 2: 48, Atragene 2: 69, Azalea 2: 51, **Berberis** 2: 41, Betula 1: 60, Boletus 1: 3, Buxus 2: 17, **Carpinus** 2: 6, Celtis 2: 19, Colutea 2: 88, Corispermum 2: 112, Cornus 2: 22, Crataegus 1: 24, Cupressus 2: 11, Cynoglossum 2: 96, Cytisus 1: 73, **Daphne** 1: 53, Diospyros 2: 20, **Elaeagnus** (Eleagrus) 1: 10, Empetrum 2: 49, Ephedra 2: 87, Erica 2: 59, **Fagus** 2: 5, Ficus 2: 44, Fraxinus 2: 7, **Gentiana** 2: 101, **Hedera** 2: 68, Hippophae 2: 43, **Ilex** 2: 18, **Jasminum** 2: 33, Juglans 2: 2, Juniperus 2: 12, **Laurus** 2: 18, Ledum 2: 50, Ligustrum 2: 32, Lonicera 1: 55, Lycium 1: 78, **Mespilus** 1: 29, Morus 2: 9, Myrica 2: 90, **Nitraria** 1: 79, **Olea** 2: 19, **Paeonia** 2: 92, Pallasia 2: 70, Periploca 2: 68, Philadelphus 2: 59, Pinus 1: 1, Pistacia 2: 21, Platanus 2: 1, Prunus 1: 15, Punica 2: 67, Pyrus 1: 20, **Quercus** 2: 3, **Rhamnus** 2: 23, Rhododendron 1: 43, Rhus 2: 38, Ribes 2: 34, Robinia 1: 68, Rosa 2: 60, Ruscus 2: 89. **Salix** 2: 74, Sambucus 2: 28, Sorbus 1: 28, Spiraea 1: 32, Staphylea 2: 32, Swertia 2: 98, **Tamarix** 2: 72, Taxus 2: 17, Tilia 2: 8, **Ulmus** 1: 75, **Vaccinium** 2: 45, Viburnum 2: 30, Viscum 2: 91, Vitex 2: 44, Vitis 2: 40.

According to the English traveler Edward Daniel Clarke (1769–1822), who lodged with Pallas at Simferopol (Achmedchid) in the Crimea for two months in 1800, the drawings for the last two volumes were then all finished and the text needed little addition, but owing to the tyrannical rule of the mad Tzar Paul, they could not be published in Russia. The plates for the first part of vol. 2 had been printed by March, 1800, but the descriptive matter had not then arrived at Petrograd from Germany. Clarke says that the Russian authorities confiscated the proof-sheets sent to Pallas from Leipzig. Hence the extremely rare 25 extra plates listed by Jackson are all of vol. 2 that

saw the light; they are without text. See E. D. Clarke, *Travels* **1**: 458 (1810) and W. Otter, *Life and Remains of Edward Daniel Clarke*, **2**: 9, 59, 65, 87 (1825).

An English life of Pallas is contained in the volume on dogs by Charles Hamilton Smith in William Jardine's *Naturalist's Library* **9**: 17–76 (1839).

LINDLEY LIBRARY,
ROYAL HORTICULTURAL SOCIETY,
LONDON, ENGLAND.

STUDIES OF PAPUASIAN PLANTS, II*

A. C. Smith

MONIMIACEAE

In studying the Monimiaceae of the area under consideration, the basic works of Perkins and Gilg (Pflanzenr. 4 (IV. **101**). 1901) and Perkins (Pflanzenr. 49 (IV. **101**. Nachtr.). 1911; Bot. Jahrb. **52**: 191–218. 1915) are of inestimable importance. By far the greater part of the Papuasian material available to these workers was collected in Northeastern New Guinea, and hence it is not surprising that the collections of the Archbold Expeditions, from British and Netherlands New Guinea, contain a considerable percentage of novelties. Many of the present specimens are in fruiting condition, particularly in the genus *Kibara;* however, this genus is readily recognizable in fruit, and since foliage and fruit characters appear the most important in specific identification, I have ventured to describe as new three species of *Kibara* without flowers. The generic limits recognized by Perkins are accepted in this treatment, and the sequence established by her is followed. I have been privileged to examine the material deposited in the herbarium of the New York Botanical Garden (NY) as well as that in the herbarium of the Arnold Arboretum (A); the place of deposit is shown by the parenthetical letters, in the absence of which the specimen is to be found only at the Arnold Arboretum. Type fragments and original drawings of many of Perkins' species in the Gray Herbarium have greatly facilitated my work.

Hedycarya Forst.

Hedycarya solomonensis Hemsl. Kew Bull. **1895**: 137. 1895; Perk. Pflanzenr. 49 (IV. **101**. Nachtr.): 6. 1911.

Solomon Islands: Bougainville: Koniguru, Buin, alt. 800–950 m., *Kajewski 1995, 2058.* Guadalcanal: Berandie River, sea-level, *Kajewski 2384;* Uulolo, Tutuve Mt., alt. 1200 m., *Kajewski 2561.*

The species, apparently previously known only from the type collection from San Cristoval, is common in rain-forest over a wide altitudinal range, according to Kajewski. He reports it as a tree up to

*(Botanical Results of the Richard Archbold Expeditions) See Jour. Arnold Arb. 22: 60–80. 1941.

20 m. high, known by the local names of *Kokobila* (Bougainville) and *Maroi* or *Undie* (Guadalcanal); the natives make a poultice from the leaves and apply it to sores. The ripe fruits are black, on a yellow receptacle.

Another specimen from Bougainville which may also represent the species is *Kajewski 1887* (Kugumaru, Buin, alt. 150 m.; tree to 12 m. high, in rain-forest; native name: *Cher-rau*). This plant has leaf-blades up to 30 cm. long and 11 cm. broad and is more robust throughout than those cited above. It may represent an undescribed species, but the variation within species of *Hedycarya* is unusually pronounced; additional material is desired before the extreme limits of *H. solomonensis* are known.

LEVIERIA Becc.

Levieria nitens Perk. in Perk. & Gilg, Pflanzenr. 4 (IV. **101**): 21. 1901; Pflanzenr. 49 (IV. **101**. Nachtr.): 7. *f. 3, R, S.* 1911; Bot. Jahrb. **52**: 196. 1915; S. Moore, Jour. Bot. **61**: Suppl. 41. 1923.

BRITISH NEW GUINEA: Central Division, Dieni, Ononge Road, alt. 500 m., *Brass 3805* (A, NY) (erect tree 20 m. tall, common in rain-forest, the bark brittle, dark brown, with a few scattered lenticels, the wood hard, brown, with numerous fine rays; leaves smooth, paler beneath; receptacle fleshy, yellow, the fruits orange-yellow). NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 900 m., *Brass 13086* (tree 7–8 m. high, common in mossy forest substage layer; receptacle orange, the fruits red).

The species has previously been reported only from two collections by Forbes from Sogere. No. *13086* differs from the other in having its secondary nerves slightly more spreading, but it seems to fall into a reasonable concept of the species.

Levieria squarrosa Perk. Bot. Jahrb. **52**: 196. 1915.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1800 m., *Brass 12253* (tree 3–4 m. high with weak slender branches, occasional in mossy forest seral growths; receptacle yellow, the fruits black); 18 km. southwest of Bernhard Camp, alt. 2150 m., *Brass 12493* (weak slender tree 3–6 m. high, very abundant in young seral growths of mossy forest; receptacle fleshy, orange, the fruits reddish black).

The cited specimens agree well with the description of *L. squarrosa*, otherwise reported only from Ledermann's collections in the neighboring Sepik River region of Northeastern New Guinea. A comparison with type material should be made before the Brass specimens are definitely taken as this species.

Levieria parvifolia sp. nov.

Frutex vel arbor parva 2–3 m. alta ubique sub anthesi glabra, ramulis gracilibus subteretibus apicem versus stramineis demum cinereis; foliis oppositis vel suboppositis, petiolis 4–7 mm. longis, laminis tenuiter coriaceis vel chartaceis siccitate fusco-olivaceis elliptico-oblongis, 3–5 cm. longis, 1–2 cm. latis, basi acutis et in petiolum decurrentibus, apice obtusis vel subacutis et inconspicue calloso-apiculatis, margine dentibus paucis (utrinsecus 2 vel 3) calloso-apiculatis ornatis et leviter recurvatis, costa supra valde prominula subtus subprominente, nervis secundariis utrinsecus 5–9 brevibus patentibus supra subimmersis vel leviter prominulis subtus manifeste elevatis, venulis inconspicuis subtus leviter prominulis; inflorescentiis ♀ paucis axillaribus plerumque unifloris, pedunculo gracili interdum ad 2 cm. longo bracteis 2- vel 3-jugis oppositis oblongis subacutis ad 1 mm. longis saepe ornato interdum nullo, pedicello gracili 6–13 mm. longo; floribus late cupuliformibus sub anthesi 5–6 mm. diametro, receptaculo complanato, tepalis 4 incurvatis tenuiter coriaceis late deltoideis subacutis, circiter 2 mm. longis et 4 mm. latis; carpellis 35–40 congestis 1.5–2 mm. longis leviter angulatis in stylum brevem subacutum desinentibus; receptaculo sub fructu coriaceo ad 8 mm. diametro, drupis maturis 1–5 ovoideis subacutis ad 9 mm. longis et 6 mm. latis.

British New Guinea: Central Division, Murray Pass, Wharton Range, alt. 2840 m., *Brass 4630* (A, type, NY), July 28, 1933 (forest substage tree or bush, loosely branched, 2–3 m. high; leaves shining, paler beneath; fruit smooth, yellow).

Levieria parvifolia appears to be closely related to *L. squarrosa* Perk., differing in its smaller leaf-blades with fewer serrations and the apex acute or obtuse rather than obviously acuminate, and in the presence of obvious tepals on the pistillate flowers.

Idenburgia Gibbs

Idenburgia elaeocarpoides Gilg & Schlecht. Bot. Jahrb. **58**: 247. 1923.

Northeastern New Guinea: Morobe District, Yunzaing, alt. 1350 m., *Clemens 3978* (tree, on forest hill, the trunk 30 cm. diam.; fruit green); Ogeramnang, alt. 1800 m., *Clemens 5122*. Netherlands New Guinea: 18 km. southwest of Bernhard Camp, Idenburg River, alt. 2150 m., *Brass 12661* (occasional subsidiary tree about 20 m. high, in mossy forest; leaves stiff, concave, very pale beneath; flowers white, fleshy; fruit red); Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11078* (tree 14 m. high, in old secondary forest; leaves very pale beneath; fruit red); 9 km. northeast of Lake Habbema, alt. 2740 m.,

Brass & Versteegh 10472 (tree 15 m. high, rare in mossy forest, the trunk 27 cm. diam., the crown not wide-spreading; immature flowers and fruits green; bark 5 mm. thick, black, fissured, rough; wood orange-colored).

The differences between *I. pachyphylla* and *I. elaeocarpoides,* the two new species proposed by Gilg and Schlechter in their discussion of *Idenburgia* (Bot. Jahrb. **58**: 244–248. *f. 1, 2.* 1923), do not seem very pronounced. Our material agrees better with the description of *I. elaeocarpoides,* being glabrous throughout, but it is quite possible that the two names will prove conspecific. Our specimens are all in fruit, *Brass 12661* bearing flowers as well. The specimens available to Gilg and Schlechter apparently had uniformly 1-seeded fruits, but those cited above have about half of the fruits 2-seeded; the development to maturity of the second ovule appears to take place very frequently.

The species has previously been reported only from Ledermann's original collections in Northeastern New Guinea.

Idenburgia pauciflora sp. nov.

Arbor ad 3.5 m. alta, ramulis copiosis gracilibus subteretibus apicem versus densissime et arcte brunneo-tomentellis demum glabratis et cinereis; foliis oppositis vel subopppositis vel interdum ad apices ramulorum verticillatis, petiolis gracilibus leviter canaliculatis ut ramulis tomentellis 6–11 mm. longis, laminis papyraceis vel chartaceis obovato-ellipticis, 5–7 cm. longis, 1.8–2.8 cm. latis, basi acutis vel subattenuatis, apice abrupte cuspidatis (apice ipso ad 6 mm. longo calloso), margine inconspicue nigro-calloso-serrulatis (dentibus 4–8 per centimetrum), supra siccitate brunneis et pilis debilibus pallidis paucis exceptis glabris, subtus pallidioribus et praecipue ad nervos et venulas pilis crispulis stramineis ad 0.4 mm. longis tomentellis, costa supra impressa subtus elevata, nervis secundariis utrinsecus 5–8 brevibus subrectis anastomosantibus supra acute impressis subtus prominulis, venulis supra immersis subtus paullo prominulis; inflorescentiis solitariis terminalibus paucifloris breviter racemosis sub anthesi 6–15 mm. longis, pedunculo brevi (ad 3 mm. longo) et rhachi teretibus 1–1.5 mm. diametro dense stramineo-tomentellis (pilis circiter 0.4 mm. longis), rhachi cicatricibus florum delapsorum saepe congestis conspicue ornata; bracteis submembranaceis ovato-oblongis obtusis, 4–4.5 mm. longis, circiter 2.5 mm. latis, extus pilis ad 0.7 mm. longis dense tomentellis, intus glabris, mox deciduis; floribus 6–10 per inflorescentiam mox caducis sub anthesi plerumque paucioribus, pedicellis crassis brevissimis (circiter 0.8 mm. longis) ut rhachi tomentellis; tepalis 4 membranaceis obovato-

orbicularibus mox caducis, circiter 2.5 mm. diametro, margine integris vel leviter undulatis, exterioribus ut bracteis extus conspicue tomentellis, interioribus utrinque glabris; staminibus circiter 8 glabris, filamentis carnosis complanatis circiter 0.2 mm. longis, antheris oblongis falcato-incurvatis 1.7–2 mm. longis, apice obtusis; gynaecio oblongo sub anthesi circiter 1.3 mm. longo et 1 mm. diametro, ovario pilis circiter 0.3 mm. longis dense stramineo-tomentello, stigmate sessili glabro pulvinato obscure lobato.

NORTHEASTERN NEW GUINEA: Morobe District, Yunzaing, alt. about 1400 m., *Clemens 3828* (TYPE), Aug. 11, 1936 (tree about 3.5 m. high, along forest trail; flowers cream-colored).

Idenburgia pauciflora is very distinct from the four species of the genus thus far known, being characterized by the small size of all its parts (leaves, inflorescences, and flowers) and the conspicuous tomentum of its branchlets, petioles, leaf-blades, and inflorescences. The tomentellous ovary appears to be especially noteworthy. In leaf-shape and size, the new species is perhaps most suggestive of *I. novo-guineensis* Gibbs, but characters of pubescence and inflorescence-size readily separate the two species.

STEGANTHERA Perk.

Steganthera Schumanniana Perk. Bot. Jahrb. **25:** 565. 1898; Perk. & Gilg, Pflanzenr. 4 (IV. **101**): 53. 1901; Kaneh. & Hatus. Bot. Mag. Tokyo **52:** 355. 1938.

NORTHEASTERN NEW GUINEA: Morobe District, Ogeramnang, alt. about 1600 m., *Clemens 4840*.

The cited specimen agrees well with the two previously known, both from the same general region, but often has the leaf-blades with a few inconspicuous callose-apiculate teeth on each side.

Steganthera ilicifolia sp. nov.

Frutex monoecus ad 2.5 m. altus, ramulis gracilibus subteretibus ad nodos complanatis juventute purpurascentibus et inconspicue cinereo-strigillosis mox glabris et stramineis; foliis oppositis, petiolis rugosis canaliculatis mox glabris 4–7 mm. longis, laminis chartaceis ellipticooblongis, 4.5–8.5 cm. longis, 1.5–4.5 cm. latis, basi obtusis, apice acuminatis (acumine 5–10 mm. longo calloso-apiculato), margine dentibus deltoideis conspicuis calloso-apiculatis utrinsecus 3–5 remote serratis, utrinque glabris, siccitate supra viridi-olivaceis subtus fuscis, costa supra valde elevata subtus prominente, nervis secundariis utrinsecus 4–6 arcuatis anastomosantibus utrinque conspicue elevatis, venulis copiose reticulatis utrinque valde prominulis; inflorescentiis axillaribus pauci-

floris breviter paniculatis vel racemosis sub anthesi ad 1.5 cm. longis, ubique pilis fusco-cinereis 0.2–0.3 mm. longis inconspicue adpresso-strigosis demum glabris, bracteis oblongis 1–2 mm. longis caducis, rhachi pedicellisque gracilibus, pedicellis 2–4 mm. longis, bracteolis 2 apicem pedicelli versus insertis lineari-oblongis obtusis ad 1.5 mm. longis vel nullis; floribus ♂ subglobosis 2–2.5 mm. diametro, receptaculo urceolato carnoso circiter 0.5 mm. crasso intus glabro, tepalis 4 minutis inflexis anguste imbricatis deltoideis obtusis, 0.3–0.5 mm. longis, 0.5–1 mm. latis; staminibus 4 oblongis carnosis, circiter 0.8 mm. latis, exterioribus circiter 1.2 mm. longis, interioribus paullo brevioribus, filamentis brevibus glabris, antheris apice rotundatis; floribus ♀ ut ♂ similibus vel paullo majoribus, apice mucronulatis, receptaculo intus obscure sericeo, tepalis subnullis; carpellis circiter 10 congestis parce et demum densiore pilosis 1.2–1.5 mm. longis, ovario ovoideo, stylo subulato; inflorescentiis sub fructu ad 3 cm. longis, receptaculo plerumque unico ad 6 mm. diametro, drupis maturis ut videtur 2–5 ovoideis ad 10 mm. longis et 8 mm. latis, breviter stipitatis, demum glabris, apice saepe apiculatis.

BRITISH NEW GUINEA: Central Division, Murray Pass, Wharton Range, alt. 2840 m., *Brass 4752* (A, TYPE, NY), Aug. 8, 1933 (straggling bush up to 2.5 m. high, very common, forming small thickets in forest fringes and isolated forest patches; receptacle yellow, fleshy).

This well-marked species appears most closely related to *S. Schumanniana* Perk., from which it obviously differs in its smaller conspicuously toothed leaf-blades with strongly prominulous venation, its more compact inflorescences, and its glabrous stamens.

Steganthera elliptica sp. nov.

Arbor parva ad 1.5 m. alta ubique praeter inflorescentiam parcissime cinereo-strigosam glabra, ramulis gracilibus subteretibus ad nodos complanatis mox cinereis; foliis oppositis, petiolis gracilibus rugosis 5–13 mm. longis, laminis chartaceis ellipticis, 5–9.5 cm. longis, 3–5 cm. latis, basi obtusis et in petiolum decurrentibus, apice obtusis vel breviter cuspidatis (apice ipso calloso-apiculato), margine dentibus minutis calloso-apiculatis utrinsecus 3–5 remote serratis, siccitate utrinque fusco-viridibus, costa supra conspicue elevata subtus prominente, nervis secundariis utrinsecus 4–6 leviter arcuatis marginem versus anastomosantibus supra subplanis subtus prominulis, venulis supra immersis subtus leviter prominulis; inflorescentiis axillaribus plerumque plurifloris paniculatis sub anthesi 3–8 cm. longis mox glabris, bracteis oblongis obtusis ad 1 mm. longis manifeste strigosis, pedicellis gracilibus ad 6 mm. longis saepe minute bibracteolatis; floribus ♀ ellipsoideis circiter 3 mm. longis et

2.5 mm. latis apice piloso-apiculatis, receptaculo carnoso urceolato intus dense brunneo-strigoso, tepalis subnullis, ore minuto; carpellis circiter 14 glabris 1.2–1.4 mm. longis, ovario oblongo-ellipsoideo, stylo minuto subacuto; receptaculis sub fructu plerumque (1-)2–5 per inflorescentiam coriaceis ad 1 cm. diametro, drupis maturis ut videtur 2–6 ovoideis ad 10 mm. longis et 6 mm. latis sessilibus subacutis.

NORTHEASTERN NEW GUINEA: Morobe District, Ogeramnang, alt. about 1800 m., *Clemens 5105* (TYPE), Jan. 23, 1937 (small tree 4 ft. high, in woods near water-supply; receptacle yellow, the fruits red); Mount Kudose Seggele, Ogeramnang, alt. 1850–2150 m., *Clemens 4934* (small tree 4 ft. high, in forest; receptacle yellow, the fruits red).

Steganthera elliptica is of the relationship of *S. oblongiflora* Perk. and *S. atepala* Perk., differing from both in its more completely glabrous habit and its elliptic and proportionately broader leaf-blades, which are sparsely serrate and obtuse or merely cuspidate rather than long-acuminate at apex.

Steganthera insignis Perk. Pflanzenr. 49 (IV. **101**. Nachtr.): 24. 1911; Bot. Jahrb. **52:** 202. 1915; Diels in White, Jour. Arnold Arb. **10:** 214. 1929.

NETHERLANDS NEW GUINEA: 6 km. southwest of Bernhard Camp, Idenburg River, alt. 1250 m., *Brass 13029* (small tree 2 m. high, in rain-forest undergrowth; receptacle orange-yellow, the fruits purple-black); 4 km. southwest of Bernhard Camp, alt. 850 m., *Brass 13464* (undergrowth tree 3 m. high, in rain-forest of river flood-plain; nodes of branches myrmecophilous; receptacle red, the fruits reddish brown).

This curious plant has previously been reported only from Northeastern and British New Guinea. The species was confused with *Anthobembix hospitans* (Becc.) Perk. by Perkins in her earlier treatments (Perk. & Gilg, Pflanzenr. 4 (IV. **101**): 55. 1901; in K. Schum. & Lauterb. Fl. Deutsch. Schutzg. Südsee 330. 1901). Its staminate flowers are turbinate or essentially globose, as is usual for *Steganthera*, but its pistillate flowers are somewhat patelliform, with the perianth conspicuously expanded laterally into a circular flange. This type of pistillate perianth is not otherwise found in *Steganthera* but is essentially similar to that of *Anthobembix*. The present species, therefore, seems to form a connecting link between the genera and may well be sought in *Anthobembix*. Our specimens agree well with *Brass 1331* from British New Guinea (cited by Diels), but that specimen has only pistillate flowers.

ANTHOBEMBIX Perk.

Anthobembix myrtifolia sp. nov.

Arbor gracilis 3–4 m. alta, ramulis gracilibus subteretibus purpurascentibus juventute cinereo-adpresso-strigosis mox glabris; foliis oppositis, petiolis gracilibus canaliculatis 4–6 mm. longis ut ramulis strigosis mox glabris, laminis tenuiter coriaceis oblongo-ellipticis, 3–6 cm. longis, 1–3 cm. latis, basi acutis et in petiolum decurrentibus, apice acutis vel breviter cuspidatis et calloso-apiculatis, margine integris et leviter incrassatis, utrinque glabris et siccitate fusco-viridibus, costa utrinque valde elevata, nervis secundariis utrinsecus 3–6 anastomosantibus, cum venulis copiose reticulatis utrinque valde prominulis; inflorescentiis ♂ axillaribus 1–3 cm. longis 2- vel saepe 1-floris ubique dense cinereo-adpresso-strigillosis, bracteis elongato-deltoideis ad 2 mm. longis mox delapsis, pedicellis gracilibus ad 15 mm. longis apicem versus interdum bibracteolatis (bracteolis lanceolato-oblongis acutis circiter 1.5 mm. longis); floribus mox glabris plus minusve patelliformibus circiter 2 mm. altis et 5 mm. diametro, receptaculo carnoso margines versus conspicue complanato intus obscure sericeo, tepalis minutis ut videtur 4 deltoideis acutis anguste imbricatis; staminibus 4 oblongis circiter 1 mm. latis, majoribus 1 mm. minoribus 0.7 mm. longis, filamentis carnosis dense strigoso-sericeis, antheris apice rotundatis per rimas introrsas horizontales dehiscentibus; inflorescentiis ♀ ut ♂ similibus sed plerumque unifloris; receptaculo turbinato apicem versus lateraliter paullo expanso, sub anthesi 2–2.5 mm. longo et circiter 3 mm. diametro, intus dense strigoso, tepalis ut videtur subnullis; carpellis circiter 6, 1.3–1.5 mm. longis, ovario ellipsoideo dense strigoso, stylo brevi subulato acuto glabro; pedicello sub fructu paullo incrassato ad 18 mm. longo, receptaculo coriaceo circiter 4 mm. diametro, drupis maturis paucis elliptico-ovoideis ad 13 mm. longis et 9 mm. latis, breviter stipitatis, apice rotundatis, extus conspicue rugosis.

NETHERLANDS NEW GUINEA: 18 km. southwest of Bernhard Camp, Idenburg River, alt. 2150 m., *Brass 12498* (slender tree 3–4 m. high, frequent in mossy forest seral growths), *12672* (TYPE), Feb. 1939 (tree 3 m. high, in bamboo undergrowth of mossy forest).

The type bears staminate flowers and a single detached drupe, while no. *12498* bears pistillate flowers and fruiting receptacles. The new species is peculiar in *Anthobembix* in the fact that, although its staminate flowers have the receptacle greatly expanded as is usual for the genus, the receptacle of the pistillate flowers is merely slightly expanded and is more suggestive of the genus *Steganthera*. *Anthobembix myrtifolia* is

also at once distinguished from the members of either genus by its small stiff leaves; *A. parvifolia* Perk. is perhaps its closest ally.

Anthobembix Brassii sp. nov.

Frutex subscandens, ramulis subteretibus juventute pilis crispis simplicibus 0.3–1 mm. longis densissime pallide brunneo-tomentosis demum glabris cinereis; foliis oppositis vel suboppositis, petiolis rugulosis ut ramulis decidue tomentellis mox glabris 10–22 mm. longis, laminis chartaceis elliptico-oblongis, 8–13 cm. longis, 3.5–6.5 cm. latis, basi late obtusis vel rotundatis, apice breviter cuspidatis, margine integris vel interdum utrinsecus dentibus ad 5 minutis calloso-apiculatis remote et obscure serratis, siccitate utrinque fusco-viridibus vel subtus brunneis, supra glabris, subtus tomentum crispulum cinereum evanescentem (pilis ad 0.7 mm. longis) gerentibus mox glabris, costa supra valde elevata subtus prominente, nervis secundariis utrinsecus 6–9 erecto-patentibus conspicue anastomosantibus supra valde prominulis subtus subprominentibus, venulis copiose reticulatis utrinque prominulis; inflorescentiis axillaribus vel subterminalibus cymosis vel paniculato-cymosis pauciforis (plerumque 3- interdum ad 9-floris) ad 4 cm. longis, ubique praeter florum superficies pilis fusco-stramineis 0.5–0.7 mm. longis dense tomentellis, pedunculo ad 2 cm. longo, bracteis oblongis 1.5–2.5 mm. longis caducis, pedicellis ad 7 mm. longis infra medium et apicem bracteolam unicam lineari-oblongam obtusam ad 2 mm. longam caducam gerentibus; floribus ♂ plerumque ad apices inflorescentiae ternatis supra glabris et nigrescentibus patelliformibus valde complanatis, sub anthesi ad 4 mm. altis et 9 mm. diametro, receptaculo carnoso ad margines conspicue expanso intus stramineo-strigoso, tepalis minutis vel subnullis; staminibus 4 carnosis oblongis circiter 1.2 cm. latis, majoribus sub anthesi 1.5 mm. minoribus 1.2 mm. longis, filamentis brevibus basi pilis ad 1 mm. longis conspicue brunneo-strigosis, antheris apice rotundatis per rimas introrsas horizontales dehiscentibus; floribus ♀ ut ♂ similibus, carpellis 10–14 sub anthesi 2–2.5 mm. longis, ovario oblongo-ellipsoideo pilis ad 1 mm. longis dense brunneo-setoso, stylo brevi subacuto glabro; pedunculis pedicellisque sub fructu incrassatis demum subglabris, receptaculo coriaceo saepe solitario ad 8 mm. diametro supra persistenter strigoso, drupis maturis saepe numerosis (2–10) coriaceis sessilibus ellipsoideis ad 12 mm. longis et 10 mm. latis, apice abrupte mucronatis, demum glabris, extus conspicue rugosis.

Netherlands New Guinea: 9 km. northeast of Lake Habbema, alt. 2800 m., *Brass 10261* (type), Oct. 1938 (large subscandent shrub, occasional in undergrowth of primary forest).

Anthobembix Brassii is readily distinguished by the evanescent crisp pale tomentum of its branchlets and foliage, its compact and densely tomentellous inflorescences, and its flattened flowers which are glabrous above. Probably more closely related to *A. oligantha* Perk. than to other described species, it is sharply distinct on the basis of the mentioned characters.

KIBARA Endl.

Kibara laurifolia sp. nov.

Arbor ad 6 m. alta sub fructu ubique glabra, ramulis fusco-cinereis subteretibus apicem versus 2.5–4 mm. diametro ad nodos incrassato-complanatis; foliis oppositis vel suboppositis, petiolis rugulosis crassis (2–4 mm. diametro) profunde canaliculatis 3–10 mm. longis, laminis coriaceis siccitate pallide olivaceis late ellipticis, 9–15 cm. longis, 4.5–8.5 cm. latis, basi obtusis, apice breviter cuspidatis vel subacutis, margine integris et conspicue anguste recurvatis, costa supra elevata et saepe striata subtus prominente, nervis secondariis utrinsecus 6–8 adscendentibus subrectis vel margines versus leviter arcuatis supra prominulis subtus acute elevatis, venulis reticulatis utrinque prominulis vel supra subimmersis; inflorescentiis sub fructu axillaribus vel subterminalibus 3–8 cm. longis, pedunculo ad 3 cm. longo pedicellisque paullo complanatis, pedicellis 10–27 mm. longis apicem versus incrassatis, receptaculis 2–6 per inflorescentiam vel interdum solitariis coriaceis 5–10 mm. diametro, drupis maturis pluribus coriaceis oblongo-ovoideis, ad 16 mm. longis et 10 mm. latis, stipitibus 2–3 mm. longis et crassis articulatis ornatis, apice inaequaliter apiculatis, basi obtusis vel rotundatis, extus sublevibus.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11218* (TYPE), Nov. 1938 (tree 6 m. high, common in secondary forest, the fruits unripe).

Kibara laurifolia is a species with glabrous coriaceous leaf-blades, but it does not seem closely related to any of the species in this section of Perkins' key (Bot. Jahrb. **52**: 208. 1915). Although flowers are not available, the new species seems more closely allied to *K. monticola* Perk., from which it differs in its shorter and proportionately broader leaf-blades with acute or cuspidate rather than acuminate apices, more ascending secondary nerves, and venation more obvious on the upper leaf-surface.

Kibara Archboldiana sp. nov.

Frutex vel arbor parva ad 3 m. alta, ramulis stramineis gracilibus subteretibus glabris infra nodos conspicue incrassato-clavatis pertusis intus concavis formicas hospitantibus; foliis oppositis, petiolis rugulosis

incrassatis (2–4 mm. diametro) 5–25 mm. longis, laminis chartaceis vel papyraceis oblongo-ellipticis, 15–36 cm. longis, 6–15 cm. latis, basi rotundatis vel late obtusis, apice conspicue et abrupte acuminatis (acumine gracili 1–2 cm. longo obtuso), margine integris et anguste recurvatis, utrinque olivaceis et glabris vel subtus juventute sub lente minutissime et decidue puberulis, costa supra elevata et saepe striata subtus prominente, nervis secundariis utrinsecus 6–10 arcuato-patentibus conspicue anastomosantibus supra valde elevatis subtus prominentibus, venulis copiose reticulatis utrinque valde prominulis; inflorescentiis subfasciculatis vel contracto-racemosis paucifloris sub anthesi quam petiolis multo brevioribus ad 8 mm. longis, ubique minute cinereo-puberulis, pedunculo crasso brevi, bracteis inconspicuis papyraceis suborbicularibus ad 0.4 mm. longis, pedicellis gracilibus sub anthesi 3–6 mm. longis apicem versus minute bibracteolatis; floribus ♂ subglobosis 2–4 mm. diametro, receptaculo crasse carnoso (ad 1 mm. crasso) valde cupuliformi; tepalis 6 minutis ovatis rotundatis, 4 per paria cruciatim oppositis anguste imbricatis, 2 exterioribus duplicatis; staminibus 6, 4 exterioribus 1–1.6 mm. longis, antheris subsessilibus ovoideis per rimam horizontalem semiorbicularem dehiscentibus; inflorescentiis sub fructu valde incrassatis, receptaculis 1 vel 2 coriaceis 8–12 mm. diametro, drupis maturis pluribus ovoideo-oblongis, 16–23 mm. longis, 8–10 mm. latis, breviter stipitatis (stipitibus 1–3 mm. longis superne valde incrassatis articulatis), apice inaequaliter subacutis, extus valde rugulosis.

BRITISH NEW GUINEA: Central Division, Dieni, Ononge Road, alt. 500 m., *Brass 3938* (A, NY, TYPE), May 2, 1933 (weak-branched bush or small tree 2–3 m. high, fairly common in rain-forest, the leaf-blades shining above; flowers yellow; receptacle bright orange, the drupes shining purple-black); Western Division, Fly River, 528-mile Camp, alt. 80 m., *Brass 6858* (sparse-foliaged tall shrub 2 m. high, in forest undergrowth on a ridge-top).

Kibara Archboldiana is a close relative of *K. formicarum* Becc., resembling it in foliage, the myrmecophytic habit, etc., but differing in having the secondary nerves of the leaf-blades raised instead of impressed above, the inflorescence more compact, the tepals smaller and inconspicuous, the stamens 6 rather than 8, and the drupes longer and proportionately narrower.

Kibara inamoena Perk. Pflanzenr. 49 (IV. **101**. Nachtr.): 34. 1911; Bot. Jahrb. **52**: 211. 1915.

BRITISH NEW GUINEA: Lake Daviumbu, Middle Fly River, *Brass 7560* (undergrowth tree 5 m. high, in rain-forest; leaves smooth and shining, the nerves prominent on both sides).

The cited specimen agrees very well with the type collection of the species in foliage, although the leaf-blades of our specimen are often faintly puberulent beneath and have the areoles of the veinlet-reticulation slightly larger. The range of variation of the species cannot be fully understood at present; it has previously been represented only by two collections from Northeastern New Guinea. The Brass specimen, in fruit, has the inflorescences to 6 cm. long, the pedicels 13–22 mm. long, the receptacle 4–10 mm. in diameter, and the drupes ovoid-ellipsoid, to 13 by 10 mm., subacute, short-stipitate.

Kibara papuana sp. nov.

Frutex vel arbor parva ad 2 m. alta ubique praeter flores glabra, ramulis gracilibus stramineis subteretibus vel apices versus complanatis; foliis oppositis vel suboppositis, petiolis gracilibus canaliculatus 3–10 mm. longis, laminis papyraceis translucentibus oblongo-ellipticis, 9–17 cm. longis, 3.5–7 cm. latis, basi obtusis et in petiolum paullo decurrentibus, apice cuspidatis (apice ipso ad 5 mm. longo obtuso), margine integris, utrinque olivaceis, costa supra subplana vel leviter elevata subtus prominente, nervis secundariis utrinsecus 6–9 arcuato-adscendentibus supra prominulis vel subplanis subtus elevatis, venulis reticulatis utrinque paullo prominulis vel supra subimmersis; inflorescentiis axillaribus vel e ramulis inter folia orientibus fasciculatis paucifloris (in specimine nostro 1- vel 2-floris), bracteis deltoideis subacutis ad 1 mm. longis, pedicellis crassis sub anthesi circiter 2 mm. longis, apice quadribracteolatis (bracteolis late deltoideis vel semiorbicularibus obtusis, inferioribus circiter 0.5 mm. longis et 1 mm. latis, superioribus circiter 1 mm. longis et 1.5 mm. latis infra tepala orientibus); floribus ♂ 2–2.5 mm. longis et diametro, receptaculo tenuiter carnoso leviter cupuliformi; tepalis 6 submembranaceis late semiorbicularibus, circiter 1 mm. longis, 1.5–2 mm. latis, apice rotundatis, luteo-glandulosis, 4 per paria cruciatim oppositis, 2 exterioribus duplicatis; staminibus 6 obovoideis circiter 0.8 mm. latis, 4 exterioribus circiter 1.2 mm. longis, 2 interioribus paullo brevioribus, filamentis gracilibus dense stramineo-sericeis, antheris late deltoideis obtusis per rimam horizontalem semiorbicularem dehiscentibus; floribus ♀ ut ♂ plus minusve similibus, receptaculo subcomplanato intus dense aureo-setuloso, tepalis paullo majoribus calyptra sub anthesi supra receptaculum circumscisse deciduis; carpellis 7 ovoideis circiter 1.5 mm. longis, ovario dense stramineo-sericeo, stylo brevi; inflorescentiis sub fructu incrassatis, receptaculis 1 vel 2 coriaceis stipitibus exceptis ad 7 mm. diametro, drupis maturis pluribus ellipsoideis, 12–18 mm. longis, 7–11 mm. latis, interdum paullo lateraliter compressis, stipitibus crassis

(ad 3 mm. diametro) 4–6 mm. longis ornatis, apice obtusis vel rotundatis, extus saepe valde tuberculato-rugosulosis.

BRITISH NEW GUINEA: Central Division, Dieni, Ononge Road, alt. 500 m., *Brass 3798* (NY, TYPE), Apr. 20, 1933 (shrub 2 m. high, in rain-forest understorey; leaves shining on both sides; flowers yellow; drupes black, wrinkled), *Brass 3992* (A, NY) (tall bush or small tree, in rain-forest understorey; leaves flat, smooth; drupes rugose, yellow-green, at length pale purple); Iawarere, alt. about 300 m., *Brass 668* (large weak shrub, in rain-forest; drupes yellow).

All the cited specimens bear fruits, but only the type has flowers, and these are very few, so that the above floral descriptions are based merely upon one staminate and one pistillate flower. Nevertheless, the material is sufficient to indicate that an unusual species is represented, characterized by thin entire leaf-blades of medium size for the genus, very compact and few-flowered inflorescences, short pedicels, a supplementary pair of bracteoles on the receptacle (somewhat intermediate in size and position between the pedicellary bracteoles and the tepals), and conspicuously rugulose drupes. Its alliance is apparently with *K. inamoena* Perk., a species with undulate-serrulate leaf-blades, comparatively ample inflorescences with long pedicels, and more numerous carpels.

Kibara rigidifolia sp. nov.

Arbor ad 4 m. alta sub fructu ubique glabra, ramis elongatis, ramulis stramineis crassis (apicem versus 5–7 mm. diametro) juventute conspicue angulatis; foliis suboppositis apices ramulorum versus ut videtur congestis, petiolis rugosis 2–3 mm. diametro 13–20 mm. longis, laminis tenuiter coriaceis siccitate flavovirente-olivaceis lanceolato-oblongis, 18–31 cm. longis, 4.5–7.5 cm. latis, basi attenuatis et in petiolum decurrentibus, apice conspicue calloso-apiculatis, margine leviter recurvatis interdum integris interdum dentibus utrinsecus ad 8 disperse spinulosis, costa supra leviter elevata et striata subtus prominente, nervis secundariis utrinsecus 20–27 cum aliis interspersis patentibus rectis anastomosantibus utrinque valde prominulis, venulis reticulatis utrinque paullo prominulis; inflorescentiis axillaribus sub fructu ad 3 cm. longis pauciramosis, pedunculo brevi ad 15 mm. longo, pedicellis crassis 12–15 mm. longis, receptaculis 1 vel 2 coriaceis stipitibus exceptis 6–8 mm. diametro, drupis maturis pluribus ovoideis, 12–16 mm. longis, 8–10 mm. latis, breviter stipitatis (stipitibus incrassatis 1–3 mm. longis), apice conspicue apiculatis, extus levibus vel paullo rugulosis.

BRITISH NEW GUINEA: Lower Fly River, east bank opposite Sturt Island, *Brass 8216* (TYPE), Oct. 1936 (tree 4 m. high, with long droop-

ing branches, in undergrowth on a moist shaded cliff-face in rain-forest, the branchlets 3-angled; leaves stiff, narrowly recurved at margins; receptacle orange, the drupes smooth, black).

Although the cited specimen lacks flowers, it obviously belongs in *Kibara* and, on the basis of foliage characters, seems certainly to be undescribed. It appears to be most closely related to *K. Ledermannii* Perk., from which it differs in its angled branchlets, proportionately narrower and often spinulose-margined leaf-blades, apparently more compact fruiting inflorescence, and less conspicuously stipitate drupes. Compared with *K. olivaeformis* Becc., another relative, *K. rigidifolia* is distinguished by its differently shaped proportionately broader drupe as well as by foliage details.

Kibara elongata sp. nov.

Arbor gracilis ad 2.5 m. alta sub fructu ubique glabra, ramulis stramineis elongatis gracilibus subteretibus vel ad nodos leviter incrassato-complanatis; foliis oppositis, petiolis crassis (3–5 mm. diametro) 14–20 mm. longis leviter canaliculatis, laminis tenuiter coriaceis siccitate viridi-olivaceis lanceolato-oblongis, 20–40 cm. longis, 6–11 cm. latis, basi attenuatis et in petiolum decurrentibus, apice longe acuminatis (acumine gracili 18–25 mm. longo calloso-subacuto), margine interdum dentibus paucis disperse et inconspicue spinulosis interdum integris, costa supra elevata et saepe inconspicue canaliculata subtus prominente, nervis secundariis utrinsecus 10–14 cum aliis interspersis patentibus rectis conspicue anastomosantibus utrinque acute elevatis, venulis reticulatis utrinque valde prominulis; inflorescentiis sub fructu axillaribus vel e ramulis inter folia orientibus pauciramosis 15–18 cm. longis, pedunculo 7–10 cm. longo pedicellisque gracilibus stramineis, pedicellis 2–4 cm. longis apicem versus incrassatis, receptaculis paucis (maturis circiter 2 per inflorescentiam) coriaceis stipitibus exceptis 7–12 mm. diametro, drupis maturis pluribus elliptico-oblongis, 22–27 mm. longis, 8–12 mm. latis, breviter stipitatis (stipitibus incrassatis 3–4 mm. longis et diametro), apice rotundatis et minute apiculatis, basi obtusis, extus rugulosis, semine siccitate nigrescente.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13349* (TYPE), Mar. 1939 (slender tree 2.5 m. high, occasional in flood-plain rain-forest; receptacle orange, the drupes black).

Kibara elongata is related to the preceding new species (*K. rigidifolia*) and its allies, but is clearly distinguished by its long-acuminate leaf-blades and its elongate peduncles, pedicels, and drupes. In the latter

character it is suggestive of *K. olivaeformis* Becc., from which the acuminate and proportionately narrower leaf-blades and the elongate inflorescences distinguish it.

PALMERIA F. Muell.

Palmeria arfakiana Becc. Malesia **1**: 186. 1877; Perk. & Gilg, Pflanzenr. 4 (IV. **101**): 65, *f. 18, L, M.* 1901; Gibbs, Contr. Phyt. & Fl. Arfak Mts. 135. 1917.

NORTHEASTERN NEW GUINEA: Morobe District, Ogeramnang, alt. 1700–1800 m., *Clemens 4485* (tree 10 m. high, on forest-margin; buds green to reddish), *5169* (small tree, on forest hill; flowers gray); Tobou, alt. about 1650 m., *Clemens 6550*.

The species has previously been reported only from the Arfak Mountains in Netherlands New Guinea; our specimens precisely match a fragment of the type collection. The first two specimens cited bear staminate flowers, the last fruits. In his original publication Beccari described only foliage and pistillate flowers; Gibbs later added a description of staminate flowers, but this description does not entirely agree with my present observations, the stamens having been mentioned as 1–4 in number. The fruit has not yet been described. Below I add a description of staminate flowers and fruits based on the cited material.

Staminate inflorescences axillary, to 4 cm. long, pseudopaniculate, few-branched, densely and closely cinereous-tomentellous throughout, the peduncle, rachis, and branchlets very slender, the pedicels 2–4 mm. long, the flowers subglobose or turbinate, 2–2.5 mm. in diameter slightly before anthesis; receptacle thin-carnose or membranous, obscurely puberulent within; tepals 5, inflexed in bud, deltoid-oblong, about 1.5 mm. long, long-acuminate; anthers about 15, sessile, deltoid-oblong, 0.5–0.6 mm. long, obtuse or minutely apiculate, often obscurely puberulent distally; fruiting inflorescences lax, to 12 cm. long, the branchlets sparsely puberulent, the fruiting receptacles irregularly subglobose, to 12 mm. in diameter, glabrescent, abruptly apiculate at apex, thin, brittle, the drupes 1–5, ovoid, angled by mutual pressure, about 7 mm. long and 5 mm. broad.

Palmeria incana sp. nov.

Frutex scandens, ramulis gracilibus rectis subteretibus densissime et minutissime stellato-cinereo-puberulis ad nodos complanatis; foliis oppositis vel subopppositis, petiolis 6–9 mm. longis ut ramulis puberulis, laminis tenuiter coriaceis oblongis, 9–16 cm. longis, 3.5–6.5 cm. latis, basi rotundatis vel late obtusis, apice breviter acuminatis (acumine ad 1 cm. longo obtuso), margine integris et anguste recurvatis, supra fusco-

olivaceis subnitidis glabris (vel ad costam sparse stellato-puberulis), subtus indumento albo-cinereo arcto densissime indutis (pilis minutis stellatis multiramosis, ramulis ad 0.1 mm. longis), costa supra conspicue impressa subtus prominente, nervis secondariis utrinsecus 7–9 patentibus rectis anastomosantibus supra inconspicuis subplanis subtus valde prominulis, venulis copiose reticulatis supra immersis subtus prominulis; inflorescentiis sub fructu axillaribus anguste paniculatis 2–8 cm. longis, rhachi, ramulis brevibus et pedicellis crassis (ad 3 mm. longis) dense stellato-puberulis; receptaculis sub fructu subglobosis vel late obovoideis maturitate 10–16 mm. diametro cinereo-puberulis demum glabrescentibus, apice vestigio perianthii conspicue apiculatis, coriaceis, ad 1 mm. crassis, demum irregulariter fissis, intus pilis stramineis ad 0.8 mm. longis setosis; drupis 1–5 per receptaculum ovoideis ad 7 mm. longis et 5 mm. latis.

BRITISH NEW GUINEA: Central Division, Mafulu, alt. 1200 m., *Brass 5427* (A, TYPE, NY), Nov. 3, 1933 (large climber in lower primary forest; leaves gray beneath; fruiting receptacles red, the drupes black).

Although flowers are not available, there seems no doubt that the cited collection represents a new species of *Palmeria*, characterized by the persistent and extremely close and dense whitish tomentum of the lower surfaces of leaf-blades. *Palmeria incana* does not seem closely allied to described species, but it is perhaps of the relationship of *P. hypochrysea* Perk. and *P. hypargyrea* Perk. It differs from both in the above-mentioned pubescence, and in its somewhat larger leaf-blades which are thicker in texture.

Palmeria habbemensis sp. nov.

Frutex parvus scandens 2–3 m. altus, ramulis gracilibus elongatis purpurascentibus quadrangularibus demum subteretibus cinereo-stellato-puberulis demum glabrescentibus; foliis oppositis, petiolis gracilibus 3–8 mm. longis ut ramulis vel densiore puberulis, laminis tenuiter coriaceis oblongis, (3.5–) 4–6 cm. longis, (1.3–) 1.5–2.8 cm. latis, basi ex rotundatis subacutis, apice breviter acuminatis (acumine 3–8 mm. longo subacuto), margine integris, supra pilis stellatis flavescentibus minutis paucis obtectis mox glabris, subtus indumento stramineo arcto densissime indutis (pilis stellatis multiramosis, ramulis 0.1–0.15 mm. longis), costa supra impressa subtus valde elevata, nervis secundariis utrinsecus 4–6 patentibus anastomosantibus supra immersis vel leviter insculptis subtus valde prominulis, venulis supra immersis subtus paullo prominulis indumento obscuris; inflorescentiis ♂ axillaribus anguste paniculatis (1.5–) 2–5 cm. longis pauciramosis ubique pilis stramineis

stellatis multiramosis minutis (circiter 0.15 mm. diametro) dense obtectis, bracteis linearibus ad 3 mm. longis caducis, pedicellis gracilibus sub anthesi 4–9 mm. longis, bracteolis linearibus parvis vel nullis; floribus sub anthesi 4.5–5.5 mm. diametro, receptaculo tenuiter carnoso, tepalis 5 vel 6 subcoriaceis deltoideis acutis 1.5–2 mm. longis et latis; staminibus circiter 25, antheris sessilibus deltoideo-oblongis obtusis, circiter 0.8 mm. longis, glabris vel apicem versus obscure puberulis.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2800 m., Oct. 1938, *Brass 10590* (TYPE), *10591* (scrambling shrubs 2–3 m. high, common in young second growths of forest clearings; upper surface of leaves smooth and shining).

This species and the following appear to represent a small-leaved montane group in *Palmeria*, probably closely related to the preceding species (*P. incana*) of lower altitudes, but differing in obvious foliage characters. Among other described species, these two suggest *P. pulchra* Perk., another small-leaved species from high elevations in Northeastern New Guinea. However, our species apparently have the tomentum of the lower surfaces of the leaf-blades denser. In the original publication (Pflanzenr. 49 (IV. **101**. Nachtr.): 38. 1911) of *P. pulchra*, authentic material of which is not available to me, Perkins refers to "folia . . . subtus pilis stellatis minutis instructa," while in her more recent key (Bot. Jahrb. **52**: 214. 1915) she refers to the hairs as "zerstreuten." Neither of these remarks suggests the dense persistent tomentum which entirely obscures the lower leaf-surfaces of the present two new species. The inflorescences of our species are apparently more reduced than those of *P. pulchra*. *Palmeria habbemensis* and its relative from the Wharton Range are distinguished from each other as follows:

Leaf-blades (3.5–) 4–6 cm. long, (1.3–) 1.5–2.8 cm. broad; inflorescence (1.5–) 2–5 cm. long; stamens about 25, the anthers strictly sessile . . . . . *P. habbemensis.*

Leaf-blades 1.8–3.5 cm. long, 0.6–1.8 cm. broad; inflorescence 0.5–2 cm. long; stamens 15–20, with short but obvious filaments. . . . *P. montana.*

Palmeria montana sp. nov.

Frutex parvus multiramosus scandens 2–3 m. altus, ramulis gracilibus subteretibus cinereo-stellato-puberulis mox glabris; foliis oppositis vel suboppositis, petiolis gracilibus 1.5–4 mm. longis ut ramulis puberulis, laminis chartaceis ovatis vel ovato-oblongis, 1.8–3.5 cm. longis, 0.6–1.8 cm. latis, basi rotundatis vel late obtusis, apice acuminatis (acumine 2–7 mm. longo subacuto), margine integris et leviter recurvatis, supra glabris vel pilis stellatis cinereis minutis sparsim obtectis, subtus indumento albo-cinereo arcte densissime indutis (pilis stellatis multiramosis,

ramulis circiter 0.1 mm. longis), costa supra impressa subtus elevata, nervis secundariis utrinsecus 3–5 brevibus inconspicue anastomosantibus supra subplanis subtus paullo prominulis, venulis reticulatis utrinque immersis vel supra visibilibus; inflorescentiis ♂ axillaribus racemosis 0.5–2 cm. longis paucifloris ubique indumento cinereo denso indutis (pilis stellatis circiter 0.15 mm. diametro), bracteis oblongis ad 2 mm. longis caducis, pedicellis gracilibus sub anthesi 3–7 mm. longis bracteolam lineari-oblongam 1.5–2.5 mm. longam prope medium interdum gerentibus; floribus sub anthesi circiter 5 mm. diametro demum ad 10 mm. diametro apertis, receptaculo tenuiter carnoso intus interdum obscure puberulo, tepalis 5 submembranaceis elongato-deltoideis acutis, circiter 4 mm. longis et 2.5 mm. latis; staminibus 15–20, filamentis brevibus circiter 0.4 mm. longis tenuiter carnosis, antheris deltoideo-oblongis obtusis glabris 0.8–0.9 mm. longis; inflorescentiis ♀ ut ♂ plus minusve similibus; floribus subglobosis sub anthesi 2–2.5 mm. diametro, receptaculo carnoso 0.3–0.4 mm. crasso intus conspicue stramineo-setoso, tepalis 5 inconspicuis inflexis deltoideis circiter 0.4 mm. latis; carpellis 10–15 sub anthesi 1.5–2 mm. longis, ovario oblongo-ellipsoideo distaliter puberulo in stylum subulatum attenuato; receptaculis sub fructu irregulariter subglobosis ad 15 mm. diametro coriaceis mox glabris demum irregulariter fissis, intus pilis stramineis ad 0.7 mm. longis setosis; drupis 1–5 per receptaculum.

BRITISH NEW GUINEA: Central Division, Murray Pass, Wharton Range, alt. 2840 m., *Brass 4667* (A, TYPE, NY), July 31, 1933 (scandent much-branched slender shrub about 2 m. high, growing along forest fringing borders; leaves pale, recurved at margin, pale brown-pubescent beneath; flowers cream-colored; fruit irregularly bursting, the seeds shining reddish brown), *4751* (slender bush of somewhat scandent habit 2–3 m. high, not common in forest undergrowth; leaves gray-brown beneath; flowers cream-colored).

The type bears pistillate inflorescences and fruits, no. *4751* staminate inflorescences. The latter specimen has leaves averaging somewhat larger than those of the type collection, but in view of the similarity of the two collections in other respects it seems likely that no. *4667* was merely growing in a comparatively exposed situation.

Palmeria Fengeriana Perk. Pflanzenr. 49 (IV. **101**. Nachtr.): 39. 1911; Bot. Jahrb. **52**: 216. 1915.

BRITISH NEW GUINEA: Central Division, Mafulu, alt. 1700 m., *Brass 5360* (A, NY) (scandent shrub in mountain-crest forest; flowers cream-colored). NETHERLANDS NEW GUINEA: Bele River, 18 km.

northeast of Lake Habbema, alt. 2200 m., *Brass 11367* (large scrambling shrub on bank of river); 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1800 m., *Brass 12307* (large scrambling shrub, common in open places in mossy forest).

The above-cited specimens are referred to *P. Fengeriana* with some hesitation, since they differ in certain respects from the original description. Our specimens have the leaf-blades up to 17 cm. long, the secondary nerves often as few as 5 per side, the inflorescences up to 35 cm. long and 15 cm. broad, and the staminate flowers up to 7 mm. in diameter. These appear to be characters of degree only, and I believe that the specimens fall into *P. Fengeriana* as delimited by the several citations in the second reference above, although I have seen none of this material. Among our specimens, no. *5360* has the hairs of the inflorescence and of the lower leaf-surface cinereous or whitish rather than dull yellow.

The species has previously been reported only from Northeastern New Guinea. *Palmeria paniculata* Ridley, from Netherlands New Guinea, seems closely related to *P. Fengeriana* and perhaps conspecific, although the leaves are said to be glabrous. Examination of type collections is desirable before the cited Brass material is finally placed.

Palmeria puberula sp. nov.

Frutex scandens, ramulis elongatis gracilibus purpurascentibus subteretibus parce cinereo-stellato-puberulis mox glabris; foliis oppositis, petiolis gracilibus 8–13 mm. longis ut ramulis puberulis, laminis papyraceis oblongo-ellipticis, 11–16 cm. longis, 5–8 cm. latis, basi obtusis, apice cuspidatis vel breviter acuminatis, margine integris et leviter recurvatis, supra glabris vel ad costam pilis stellatis parvis sparsim obtectis, subtus pilis stramineis stellatis multiramosis parvis (0.2–0.3 mm. diametro) paucis instructis demum glabrescentibus, costa supra leviter impressa subtus prominente, nervis secundariis utrinsecus 5–9 erecto-patentibus anastomosantibus supra minute prominulis subtus elevatis, venulis reticulatis utrinque paullo prominulis vel supra subplanis; inflorescentiis ♂ axillaribus vel e ramulis infra folia orientibus paniculatis multifloris valde ramosis, 10–15 cm. longis, 5–8 cm. latis, ubique (praecipue floribus) pilis stellatis adpressis minutis ad 0.1 mm. diametro densissime cinereo-puberulis, rhachi gracili subtereti demum glabrescente, bracteis parvis elongato-oblongis mox caducis, bracteolis ut videtur subnullis, pedicellis gracilibus sub anthesi 3–5 mm. longis; floribus late cupuliformibus sub anthesi 4–6 mm. diametro, receptaculo submembranaceo explanato, tepalis 5 membranaceis deltoideis 3–3.5 mm. longis et latis apice conspicue angustatis et acuminatis; staminibus 30–35, antheris sessilibus oblongo-deltoideis obtusis 0.8–1 mm. longis.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., March 1939, *Brass 13463* (TYPE) (large scandent shrub, on an open river-bank in rain-forest; flowers yellow).

Palmeria puberula is characterized by its sparsely pubescent leaf-blades, its closely pale-stellate-puberulent inflorescences, and its large flowers. Related to *P. Fengeriana* Perk. and *P. paniculata* Ridley, it is distinguished from both by its very different type of pubescence. Its relationship may also be with *P. myriantha* Perk., a species with sparser pubescence throughout, smaller leaves, and much smaller flowers.

ISOMEROCARPA gen. nov.

Arbores saepe procerae, foliis oppositis petiolatis, laminis chartaceis vel coriaceis margine serratis vel subcrenatis; inflorescentiis axillaribus solitariis brevibus cymosis paucifloris pedunculatis; floribus hermaphroditis pedicellatis ubique glandulosis saepe ternatis, bracteis parvis caducis, pedicellis apice bracteolas 2 papyraceas valvatim involucrantes nox deciduas gerentibus, cicatricibus sub anthesi conspicuis; receptaculo carnoso urceolato extus apicem versus tepala stamina et staminodia gerente; tepalis 8 biseriatis tenuiter coriaceis oblongis sub anthesi patentibus, 4 exterioribus et 4 interioribus similibus; staminibus 4–9 carnosis, filamentis brevissimis crassis utrinsecus glandula aliformi auctis, antheris extrorso-lateraliter bilocellatis, locellorum valvis sursum dehiscentibus, connectivo in appendiculam complanatam producto; staminodiis 2- vel 3-seriatis intra stamina 9–16 lanceolato-oblongis, exterioribus manifeste majoribus; carpellis 10–12 in fundo receptaculi congestis, in stylos subulatos exsertos desinentibus, ovulo basim ovarii versus suberecto; receptaculo fructifero ellipsoideo vel anguste ovoideo coriaceo in valvas 3 vel 4 subaequales dehiscente, fructus carpellis inclusis angustis longe pilosis in stylos longos desinentibus, pericarpio tenui semini adnato.

Isomerocarpa is proposed to include *Daphnandra novoguineensis* Perk., originally described on the basis of a fruiting specimen; in this condition the plant is indeed so suggestive of the Australian species of *Daphnandra* that one would not seriously question its place, although the dehiscence of the fruiting receptacle is different. In describing a second New Guinean species of this alliance, Gilg and Diels (Notizbl. Bot. Gart. Berlin **9**: 466. 1925) apparently did not consider the generic placing of their plant, as flowering specimens are quite unlike those of *Daphnandra*. The presence of involucrate bracteoles beneath each flower is in itself a sufficiently pronounced character to remove the New Guinean species from *Daphnandra* according to Perkins' key to genera (Pflanzenr. 4 (IV. **101**): 14. 1901).

Isomerocarpa differs from *Daphnandra* in the presence of the above-mentioned involucrate bracteoles, in having the tepals 8 and the members of both series similar in number and texture (the tepals of *Daphnandra* being 10–15, those of the inner series more numerous, larger, and thinner in texture than those of the outer), in the somewhat produced and conspicuouly flattened anther-connective, in the essentially basal rather than pendulous ovule, and in having the fruiting receptacle dehiscing into three or four subequal valves (rather than inequilaterally along one side as in *Daphnandra*).

A closer relative of the new genus appears to be the Australian *Atherosperma* Labill., which agrees with the New Guinean plants in having paired bracteoles beneath each flower. *Isomerocarpa,* however, differs from *Atherosperma* in having its flowers hermaphrodite rather than dioecious or polygamo-monecious, in having its stamens 4–9 rather than 10–16 and its filaments inconspicuous (those of *Atherosperma* being slender and obvious), in its produced anther-connective, and in its ellipsoid fruiting receptacle (that of *Atherosperma* being either subglobose or urceolate). The staminate flowers of *Atherosperma* completely lack both staminodes and carpels, the receptacle being flattened, while the pistillate flowers have more numerous (at least 25) carpels than those of *Isomerocarpa.* The staminodes of *Atherosperma,* present only in pistillate flowers, are arranged on the inner surface of the receptacle above the carpels, while the new genus has the staminodes on the distal outer surface of the receptacle.

Isomerocarpa, a member of the Subfamily Atherospermoideae, Tribe Laurelieae, according to Perkins' treatment, seems to have as strong a combination of characters as any of the five genera of this relationship treated in the *Pflanzenreich.* These genera, although small, are well marked and will presumably seem quite acceptacle to future monographers. The name of the new genus refers to the fact that the fruiting receptacle splits into equal valves.

Isomerocarpa novoguineensis (Perk.) comb. nov.

Daphnandra novoguineensis Perk. Bot. Jahrb. **52**: 217. *f. 5.* 1915.

Northeastern New Guinea: Morobe District, Ogeramnang, alt. about 1800 m., *Clemens 4598* (tall tree in forest hills, the trunk 38–60 cm. diam., the buds greenish white), *4796, 5456;* Yunzaing, alt. about 1400 m., *Clemens 3853* (tall tree, the trunk 60 cm. diam. or more; fruit green; tree growing with *Calophyllum* sp.). British New Guinea: Central Division, Ononge Road, alt. 500 m., *Brass 3913* (gray-barked tree in rain-forest, the leaves thick, dark, pale beneath; flowers brown;

fruit green, hard). NETHERLANDS NEW GUINEA: Balim River, *Brass & Versteegh 11194* (on forested slopes at 2160 m.; tree 26 m. high, the trunk 60 cm. diam., the crown fairly wide-spreading, the bark thick, gray, 18 mm. thick, the wood brown; flowers red; fruits green); 4 km. southwest of Bernhard Camp, Idenburg River, alt. 900 m., *Brass 13085* (common subsidiary tree 10–12 m. high, in mossy forest; flowers yellow, with red stamens); 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11948* (tree 25 m. high, frequent in primary forest at 1590 m. alt., the trunk 44 cm. diam., the crown not wide-spreading, the bark 11 mm. thick, dark brown, the sap-wood yellow, the heart-wood brown-yellow; fruits light green), *11984* (tree 31 m. high, frequent in primary forest on the slope of a ridge at 1900 m. alt., the trunk 60 cm. diam., the crown not wide-spreading, the bark 12 mm. thick, rough, fissured, the sap-wood light yellow, the heart-wood brown-yellow; flowers red).

The species has previously been reported only from Northeastern New Guinea. The above-cited specimens agree well with the original description, although they may equally well be referred to *Daphnandra Perkinsiae* Gilg & Diels. From a comparison of the two descriptions I am inclined to doubt the existence of two species, as the differences in leaf-size, texture, apex, and punctation mentioned by Gilg and Diels seem very slight. In general, it appears that specimens from higher elevations have thicker and smaller leaf-blades, but I fail to find specific differences among those cited. The reduction cannot definitely be made without examination of the two types.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

PLANTAE PAPUANAE ARCHBOLDIANAE, VI*

E. D. Merrill and L. M. Perry

The Papuan material under study contains representatives of several families with but a few numbers each. In some groups considered below the material is entirely from Netherlands New Guinea (Third Archbold Expedition), the Fly River collections having previously been named and recorded, while in others our total material of the family is considered. Included also are a few specimens, misplaced in the original hasty ordering up of the collections for reference, representing families previously considered. The new species and the range extensions here recorded were detected in our effort to complete the identifications of the material in certain of these smaller families. As far as we know, no representatives of the genera *Elaeagnus, Crypteronia, Duabanga,* and *Callitriche* have previously been reported from New Guinea. *Elaeagnus* and *Callitriche* were to be expected, as both have long been known as occurring in Malaysia and in Australia. *Duabanga* and *Crypteronia* are small genera characteristic of Malaysia, New Guinea perhaps representing the southeastern limits of their geographic range.

ULMACEAE

Celtis Linnaeus

Celtis similis sp. nov.

Arbor 8 m. alta, trunco 25 cm. diametro; ramulis brunnescentibus glabris, novellis adpresse pubescentibus, pilis flavescentibus; foliis subcoriaceis petiolatis, pro more affinium eximie trinerviis, lanceolato- ad ovato-ellipticis, 2.5–5 cm. longis, 1.2–2.2 cm. latis, basi subrotundatis vel obtusis paullo obliquis, apice saepe longe acuminatis, acumine 0.4–1.2 cm. longo, acuto vel subapiculato, margine integris vel supra medium remote serratis, supra glabris vel novellis parce pubescentibus, subtus praecipue in costa nervisque primariis parce pubescentibus, axillis plerumque minute fasciculato-barbatis; costa recta in tertia parte supera nervos utrinsecus 1–2 emittente, nervis basalibus 2 superne evanescentibus, exterius ± 4 venas laterales arcuatim anastomosantes emittentibus; venularum reticulo ± inconspicuo; stipulis ipsis non visis; petiolo

*(Botanical Results of the Richard Archbold Expeditions) See Jour. Arnold Arb. **20**: 324–345. 1939; op. cit. **21**: 163–200, *t. 1.* 1940; op. cit. 292–327; op. cit. 511–527; op. cit. **22**: 32–59. 1941.

1.5–3 mm. longo, adpresse pubescente; cymis axillaribus fructiferis ± 1 cm. longis, pedunculis 3–5 mm. longis, pubescentibus; drupis late ellipsoideis, leviter compressis, apice pubescentibus obtuse apiculatis, putamine 2 mm. longo, 2.5 mm. lato, ruguloso.

NETHERLANDS NEW GUINEA: Balim River, *Brass & Versteegh 11168* (TYPE), December 1938, alt. 1600 m., relic strip of primary forest on river bank (tree 8 m. high, 25 cm. diameter; bark gray; fruit green).

Celtis similis is undoubtedly closely related to *C. rubrovenia* Elmer of the Philippine Islands. The leaves, petioles and fruits are a little smaller than in the latter species, and the new growth is densely pubescent. Further, the leaves lack the puncticulations characteristic of the Philippine species, and differ also in that, usually, minute tufts of hairs are present in the axils of the larger veins on the lower surface.

Celtis Kajewskii sp. nov.

Arbor usque 25 m. alta; ramulis cinereo-brunnescentibus glabris, innovationibus pubescentibus; foliis subcoriaceis, petiolatis, trinerviis, ovato-ellipticis, 10–19 cm. longis, 6–10 cm. latis, apice (± fractis) probabiliter acuminatis, basi rotundato-obtusis vel brevissime cuneatis, paullo obliquis, margine integris, supra glabris vel costa nervisque parce pubescentibus, subtus praecipue in costa venisque parce pubescentibus; costa recta, nervis primariis 2 tantum conspicuis a basi ad apicem laminae arcuatim productis, exterius venas laterales plures intra marginem arcuatim anastomosantes emittentibus, venularum reticulo supra manifesto, subtus prominulo; stipulis ipsis non visis; petiolo 7–10 mm. longo, ± adpresse pubescente; cymis fructiferis usque 5 cm. longis; drupis elongato-ovoideis subtetragonis, 2 cm. longis, ± 1.5 cm. latis, stigmate bilobo coronatis, parce pubescentibus vel glabratis.

SOLOMON ISLANDS: Guadalcanal, Berande, *Kajewski 2445* (TYPE), January 1931, common in rain-forest at sea level (very large tree up to 25 m. high, with straight stem and little buttressed or not; fruit orange-colored when ripe, 2.5 cm. long, 1.6 cm. broad, oval shaped with a point at the end). NEW BRITAIN: Keravat Experiment Station, near Rabaul, *Kanehira 3964*.

The characters of this species approach those of *C. Zippelii* (Blume) Planchon as given in the description; in the latter, however, the two main nerves do not extend to the apex of the leaf, and the leaves are glabrous.

Parasponia Miquel

Parasponia rigida sp. nov.

Arbor usque 6 m. alta; ramulis teretibus, adpresse pubescentibus vel glabratis; foliis coriaceis alternis petiolatis lanceolatis haud ovatis, usque

8.5 cm. longis, 2.3 cm. latis, basi rotundatis paullo obliquis, apice acute acuminatis, margine in sicco leviter revolutis serrulatis, trinerviis, supra scabridulis (pilis basi bulbosis vel pustulatis), rugosis, costa atque 2 nervis adpresse pubescentibus, subtus adpresse pubescentibus ac manifeste dense reticulatis; nervis basilaribus usque ad apicem productis arcuatis, exterius venas laterales plures longiuscule arcuatas intra marginem anastomosantes emittentibus, costa interdum unam venam lateralem emittente; petiolo ± 8 mm. longo, adpresse pubescente; stipulis in costis adpresse pubescentibus in unam stipulam intrapetiolarem circiter 8 mm. longam bicuspidatam connatis; cymis axillaribus, circiter 1 cm. longis; rhachi adpresse pubescente; bracteis ovatis, fere acuminatis, circiter 1 mm. longis; floribus parvis monoicis; ♂ : perianthio 5-partito, laciniis imbricatis late obovato-ellipticis, 1.6 mm. longis, 1.2 mm. latis, obtusiusculis puberulis ciliatis; staminibus 5, filamentis 0.8 mm. longis, antheris 0.7 mm. longis, thecis oblongis, curvatis; pistilli rudimento 0.8 mm. longo angulato-obconico, apice medio paullo impresso, receptaculo hirsuto; ♀ : pedicellatis, pedicellis 1–1.5 mm. longis; perianthio 1.2 mm. longo, laciniis ovatis, puberulis, ciliatis; drupis ovoideis 2–2.4 mm. longis, 2.2 mm. latis, stigmatibus marcescentibus coronatis, basi perianthio suffultis.

Netherlands New Guinea: 18 km. southwest of Bernhard Camp, Idenburg River, *Brass 12459* (type), February 1939, alt. 2150 m., mossy forest, dominating young forest at the foot of a rock-slide (tree up to 6 m. high; branches flat-spreading; fruit red).

This species is very close to *Parasponia melastomatifolia* J. J. Sm. differing chiefly in the lanceolate leaves with a serrulate margin. The ♂ and ♀ inflorescences are on different branchlets, and the outer lateral veins are long-arcuate before anastomosing.

Parasponia simulans sp. nov.

Arbor 4–5 m. alta; ramulis teretibus, adpresse pubescentibus ad glabratis; foliis subcoriaceis vel chartaceis, alternis petiolatis lanceolatis interdum elongato-ovatis, 5.5–11 cm. longis, 1.7–4 cm. latis, basi rotundatis paullo obliquis, apice acute acuminatis, margine in sicco leviter revolutis crenulato-serrulatis, trinerviis, supra vix scabridulis, costa parce pubescente, subtus costa venis venulisque adpresse pubescentibus, dense manifesteque reticulatis, novellis subtus pubescentibus; costa recta, nervis primariis 2 tantum, conspicuis, a basi ad apicem laminae arcuatim productis, exterius venas laterales plures breviter arcuatim anastomosantes emittentibus; petiolo 6–12 mm. longo, adpresse pubescente; stipulis in unam intrapetiolarem circiter 7 mm. longam bi-

cuspidatam adpresse puberulam connatis; inflorescentiis axillaribus, ± 1 cm. longis; rhachi adpresse pubescente; floribus monoicis; ♂ : perianthio 5-partito, laciniis obovato-ellipticis, ± 1.5 cm. longis, 1.2 cm. latis, adpresse pubescentibus, ciliatis; staminibus 5, filamentis 1.5 cm. longis, antheris 0.8 mm. longis, ovoideis, thecis oblongis, curvatis; pistilli rudimento angulato-clavato; receptaculo dense hirsuto; ♀ : perianthio ♂ conformi; drupis ovoideis 2.5 mm. longis, stigmatibus marcescentibus 0.8 mm. longis coronatis, putamine late subgloboso-ovoideo, 1.4 mm. longo, 1.8 mm. lato.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, *Brass 13072* (TYPE), March 1939, alt. 850 m., common in seral rain-forest (tree 4–5 m. high).

Unquestionably *Parasponia melastomatifolia* J. J. Sm., *P. rigida* and this species are very closely related. Unfortunately we have only the plate and the original description of the first to compare with our species. *Parasponia simulans* appears to be separable from *P. melastomatifolia* J. J. Sm. by the lanceolate leaves with crenulate-serrulate margin and the relatively smooth upper surface. Comparing *P. simulans* with *P. rigida* Merr. & Perry, the following differences appear: the inflorescence of the former is more open, staminate and pistillate flowers are in the same inflorescence; the leaves are thinner, the lower surface is much less pubescent, the venation is less elevated, and the veins extending outward from the main nerves are only shortly arcuate.

ROSACEAE

Parastemon A. de Candolle

Parastemon Versteeghii Merr. & Perry, Jour. Arnold Arb. **21**: 197. 1940.

NETHERLANDS NEW GUINEA: Hollandia, *Brass 8948*, July 1938, alt. 20 m., common in dry open second growths (bushy tree 6–7 m. tall; fruits very numerous, white).

This specimen has practically mature fruits 1.7 cm. long, 0.7 cm. diameter. Their structure agrees entirely with that of the fruit of *P. urophyllus* A. DC. as delineated by Boerlage and Koorders, Ic. Bog. **1**: *t. 97*. 1901.

MELIACEAE

Dysoxylum Blume

Dysoxylum Whiteanum sp. nov.

Arbor alta; foliis alternatis, 50–60 cm. longis, 3–5-jugis, pari- atque impari-pinnatis, novellis dense apresse pubescentibus mox glabratis, petiolatis, petiolo usque 10 cm. longo, supra applanato, glabrato; foliolis

suboppositis petiolulatis chartaceis, oblongis vel inferioribus oblongo-ellipticis, 6.5–20 cm. longis, 4–6 cm. latis, basi, foliolo terminali excepto, oblique brevissime cuneatis, apice obtusis abrupte in acumen angustum ± 1 cm. longum productis utrinque glabris; venis primariis utrinsecus 12–21 obliquis, supra manifestis, subtus vix prominulis; petiolulis 1–1.8 cm. longis, terminali 3–3.5 cm. longo; racemis fasciculatis pendentibus, in axillis foliorum vel in ramulis defoliatis, usque 19 cm. longis, rhachi ac bracteis minutis adpresse pubescentibus; floribus albis sessilibus; calyce crateriformi circiter 4 mm. longo, leviter 4-lobato, adpresse pubescente, lobis vix 1 mm. longis liberis, apice parce pubescente excepta glabris; tubo stamineo circiter 6 mm. longo, utrinque glabro 8-fido, laciniis 2 mm. longis apice emarginatis, antheris 8 inter lacinias affixis, circiter 1.5 mm. longis; tubulo cylindrico 2 mm. longo, crenulato, extus margine ± dense pubescente excepta glabro, intus parce pubescente; ovario dense adpresse pubescente, 4-loculari, stylo adpresse pubescente, stigmate discoideo.

British New Guinea: Lower Fly River, east bank opposite Sturt Island, *Brass 8005* (type), October 1936, rain-forest, common on river-flats flooded by tides (profusely flowering tall canopy tree with widely flanged base; bark reddish brown, lenticellate; leaves to 50–60 cm. long; flowers white, in pendent racemes, fasciculate in leaf-axils and lateral on smaller branches).

In several characters this species suggests *Dysoxylum Pettigrewianum* F. M. Bail. It may be distinguished from the latter by the longer pendent inflorescences, the incised (rather than crenulate) apex of the staminal tube, the shorter and less hairy tubular disk, and the oblong or oblong-elliptic rather than lanceolate leaflets.

Dedicated to Mr. C. T. White in appreciation of his extensive contributions to the knowledge of the botany of northeastern Australia and his interest in the flora of New Guinea.

Dysoxylum micranthum sp. nov.

Arbor gracilis parva; ramulis glabris lenticellatis, lenticellis albescentibus, innovationibus minute pubescentibus mox glabratis; foliis alternis, 3-jugis, pari-pinnatis, petiolatis; petiolo 2.5–4.5 cm. longo et rhachi 4–6 cm. longa glabris; foliolis oppositis, sessilibus vel subsessilibus, chartaceis, lanceolatis, 7–13.5 cm. longis, 2.3–3.5 cm. latis, utrinque angustatis, basi longe angusteque cuneatis atque paullo obliquis, apice obtuse acuminatis, acumine ± 5 mm. longo, utrinque glabris; venis primariis utrinsecus 11–14, obliquis marginem versus adscendentibus, manifestis vel inconspicuis; paniculis axillaribus vel supra-axillaribus, usque 9 cm. longis, ramis brevibus vix 1 cm. longis; floribus parvis, alabastris circiter 2 mm. longis, pedicellis circiter 0.5 mm. longis; calyce

0.8 mm. longo, 4–5-dentato, margine inconspicue ciliolato; petalis 4–5, late ovatis, 1.8 mm. longis, 1.2 mm. latis, acutiusculis, glabris, tubo stamineo in parte inferiore adnatis; tubo stamineo ½ longitudinem petalorum subaequante, 8–10-fido, glabro; antheris 8–10, oblongis, semiinclusis; tubulo urceolato, 0.6 mm. longo, extus glabro, intus infra marginem pubescente; ovario subgloboso, 0.8 mm. longo, minute pubescente, 3-loculari; stylo glabro, circiter 1 mm. longo, stigmate crasso discoideo.

SOLOMON ISLANDS: San Cristobal, Star Harbor, *Brass 3114* (TYPE), October 1932, alt. 100 m., rain-forest (slender small tree with green flowers).

In the abruptly pinnate leaves and the very small flowers, this species shows some resemblance to the genus *Pseudocarapa* Hemsl.; nevertheless, on account of the free disk we have placed it in *Dysoxylum* Blume. Possibly it has an affinity with *D. arborescens* (Blume) Miq. At present we cannot suggest a species closely resembling it.

CALLITRICHACEAE

Callitriche Linnaeus

Callitriche papuana sp. nov.

Planta submersa; foliis caulinis et ramalibus linearibus uninerviis, apice profunde lunate excisis; floribus ♂ non visis; fl. ♀: ovario juvenili 0.3 mm. longo, stylis 1 cm. longis erectis vel subdivergentibus; ovario submaturo 1 cm. longo, stylis 2.2 cm. longis; fructibus maturis subsessilibus vel brevissime pedicellatis, 1.4–1.6 cm. longis, 1.2–1.4 cm. latis, suborbicularibus vel paullo longioribus quam latioribus, convexis, apice leviter cordatis, marginibus binis subapproximatis parallelis tenuiter subalatis, carinis latis acutiusculis.

NETHERLANDS NEW GUINEA: Lake Habbema, *Brass 9541* (TYPE), August 1938, alt. 3225 m., submerged (green) aquatic rooting in outer shallows of lake.

Apparently this is the first collection of *Callitriche* from New Guinea. We have been unable to match the material with any herbarium specimens or with any of the descriptions of Asiatic or Australian species. It is most like *C. stagnalis* Hegelm., but the latter has fruits more broadly winged and the apex of the leaves is emarginate rather than roundly incised.

AQUIFOLIACEAE

Ilex Linnaeus

Ilex scabridula sp. nov.

Scandens; ramis longis pendentibus; ramulis subferrugineis scabridulis ± angulatis gracilibus; foliis valde coriaceis glabris, ovatis ad oblongis,

3–7 cm. longis, 1.4–3 cm. latis, basi obtusis vel rotundatis, apice acuminatis vel interdum acutis, acumine 0.5–1 cm. longo, subapiculato, margine integris vel in parte tertia superiore 2–4-serrulatis, subtus glanduloso-punctatis; costa media supra canaliculata, subtus prominula; venis primariis supra obscuris, subtus utrinsecus 6–9 prominulis rectis vel juxta marginem arcuatim confluentibus, minoribus interdum majoribus intermixtis; petiolo 2.5–4 mm. longo, nigrescente glabro; racemis solitariis axillaribus, 1.5–3.5 cm. longis, rhachi parce pubescente, pedicellis circiter 3 mm. longis, parce pubescentibus, basi bracteatis, bracteis subrotundatis, ± 1 mm. longis; calyce 4–5-mero glabro, lobis rotundatis margine parce atque obsolete ciliolatis; corolla rotata, petalis oblongis apice rotundatis vel obtusis, circiter 2.5 mm. longis; staminibus fl. ♂ petalis fere aequalibus, antheris ovoideis, 0.8 mm. longis; pistillodio subangulato-pulviniformi, medio apiculato, circiter 0.8 mm. diametro; staminodiis fl. ♀ quam petalis brevioribus, antheris minutis; ovario obtuse ellipsoideo, compresso, 6–10-loculari, stigmate magno crasso discoideo elliptico, 1.2 mm. longo, 0.4 mm. lato; drupis ellipsoideis, 3 mm. longis, 2.5 mm. diametro, obsolete longitudinaliter sulcatis.

Netherlands New Guinea: 9 km. northeast of Lake Habbema, *Brass 10502, 10775, 11006* (type), October 1938, alt. 2800 m. and 2900 m., frequent in mossy forest of moist valleys (large liane with pendent branches forming long hanging masses of foliage; flowers white; fruit small, black).

Although somewhat resembling *Ilex spicata* Blume, this species is readily distinguished by the scabridulous branchlets; the glandular dots on the lower surface of the leaves are fairly numerous and readily seen with a hand lens; while the leaf-margin is sometimes remotely serrate towards the apex of the leaf.

Ilex Versteeghii sp. nov.

Arbor usque 21 m. alta glabra; ramis teretibus cinereis, plerumque lenticellatis; ramulis brunnescentibus subangularibus; foliis valde coriaceis subnitidis, ellipticis vel oblongis, 3.5–7(–11) cm. longis, 1.5–3.5 cm. latis, basi obtusis vel late cuneatis interdum rotundatis, apice obtusis vel retusis vel subemarginatis, margine integris plerumque revolutis, supra olivaceo-viridibus, subtus pallidioribus vel brunnescentibus non punctatis; costa supra canaliculata, subtus prominente; venis primariis utrinsecus 6–9, supra impressis, subtus prominulis, rectis ad marginem curvatis atque anastomosantibus; petiolo 4–8(–14) mm. longo, atro; inflorescentiis axillaribus, breviter pedunculatis, plerumque bis interdum ter dichotomis, 3–13-floris, pedunculo 3–7 mm. longo, pedicellis ± 3 mm. longis; floribus 5-meris; calyce glabro, lobis rotundatis minute ciliolatis;

corolla rotata, lobis oblongis rotundatis, circiter 3 mm. longis; staminibus fl. ♂ quam petalis paullo brevioribus, antheris ovoideis, 1 mm. longis; pistillodio depresse angulato-conico; staminodiis fl. ♀ non visis; ovario depresse ovoideo, 4–6-loculari, stigmate crasso discoideo, inconspicue 5-lobato, circiter 1 mm. diametro; drupis ovoideis vel subglobosis, 4 mm. longis, 3.5 mm. diametro.

NETHERLANDS NEW GUINEA: Balim River, *Brass & Versteegh 11192* (TYPE), December 1938, alt. 2180 m., forests of the slopes (tree 17 m. high, 35 cm. diameter; fruits red); *Brass 11662*, December 1938, alt. 1600 m., scattered over grassy deforested slopes (shrub 2 m. high; leaves smooth and shining, margins recurved; flowers white); 9 km. northeast of Lake Habbema, *Brass 10262, 10263, 10654*, October 1938, alt. 2800 m., common in substage of valley forests and also in old secondary forests (tree 10–15 m. high; flowers white); *Brass & Versteegh 10455*, October 1938, alt. ± 2930 m., frequent in mossy forest on ridge (tree 20 m. high, 28 cm. diameter; flowers white); Bele River, 18 km. northeast of Lake Habbema, *Brass 11290*, November 1938, alt. 2350 m., fagaceous forest of slopes, frequent in young seral growths (tree 2–3 m. high; leaves stiff, convex); 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12576*, February 1939, alt. 1350 m., frequent in primary forest (tree 21 m. high, 48 cm. diameter).

Brass 11290 is somewhat aberrant in having very long leaves. The branchlets of *Brass & Versteegh 12576* (a sterile specimen) are much lighter in color than those of the other collections. Possibly the following two collections from Balim River also belong in this species: *Brass 11771, 11772*, December 1938, alt. 1800 m. and 1700 m., common in brushy growths on dry, stony, long deforested slopes (shrub or small tree 1–3 m. high; leaves smooth and shining; flowers white). The leaves are smaller than those of the other collections, but we have not yet found any specific differences.

In the grayish branchlets and the entire impunctate leaves, *Ilex Versteeghii* is closely allied to *I. Archboldiana* Merr. & Perry; the latter, however, is a compact tree with denser foliage; the leaves are smaller, and the mesocarp is much thinner than in *I. Versteeghii*.

CELASTRACEAE

Celastrus Linnaeus

Celastrus novoguineensis sp. nov.

Probabiliter frutex scandens, glaber; ramulis teretibus vel apicem versus subangulatis, atrobrunneis, lenticellatis, lenticellis numerosis,

pallidis; foliis alternis, tenuiter coriaceis, oblongis ad ellipticis, 13–16 cm. longis, 5–7.5 cm. latis, basi obtusis vel rotundatis, apice obtusiusculis vel acutiusculis, margine minutissime remotiusculeque serrulatis, leviter revolutis, in sicco plerumque pallide viridescentibus; costa supra subplana subtus prominula; venis primariis utrinsecus 7–8 patentibus arcuatim adscendentibus, utrinque manifestis ± prominulis, reticulo laxiusculo ± distincto; paniculis terminalibus, 15–20 cm. longis, ramis 3–6 cm. longis, divaricatis vel oblique adscendentibus; ramulis usque 1–1.5 cm. longis; pedicellis 1 mm. longis; bracteis deltoideis, 0.6 mm. longis; floribus parvis; calyce 2 mm. longo, 5-lobato, lobis brevibus, rotundatis; petalis 5, ellipticis 2.5 mm. longis, staminibus 5 in margine disci locatis, filamentis brevissimis vix ullis, antheris 1 mm. longis, oblongis, subauriculatis; disco cupuliformi, 1 mm. longo, non crasso; ovario subgloboso, 0.8 mm. longo, 1.1 mm. diametro, 3-loculari; stylo brevi; stigmate quam stylo latiore 3-lobulato, lobulis bifidis; capsulis loculicide trivalvis, valvis 1 cm. longis, extus inconspicue transverseque corrugatis; seminibus ± ellipsoideis, 8 mm. longis.

NORTHEASTERN NEW GUINEA: Ogeramnang, *Clemens 5152* (TYPE), *5394*, January and February 1937, alt. ± 1750 m.; Yoangen, *Clemens 6606*, June 1937, alt. ± 1250 m.

In some characters this species suggests *Celastrus papuanus* Warb., but the latter has smaller leaves and a racemose panicle with very short branches (only 6–8 mm. long). *Clemens 3523*, a fragmentary specimen from Yunzaing may also belong here.

Perrottetia Humboldt, Bonpland & Kunth

Perrottetia traumatophylla sp. nov.

Arbor 5–7 m. alta, glabra; ramulis brunnescentibus lenticellatis, lenticellis numerosis ovalibus pallidis; foliis alternis 2–3 cm. remotis, chartaceis vel subcoriaceis, oblongo-ellipticis utrinque angustatis, 9–15 cm. longis, 3.5–6 cm. latis, basi obtuse cuneatis, apice breviter acuminatis apiculatis, margine integris vel interdum apicem versus remote minuteque denticulatis, costa supra subplana, subtus prominente; venis primariis utrinsecus 7–8 supra manifestis interdum depressis, subtus perspicuis, oblique arcuatim patenti-adscendentibus, intra marginem 2–3 mm. anastomosantibus, venulis paucis manifestis; petiolo circiter 7 mm. longo; paniculis axillaribus, 4–9 cm. longis, sub lente pulvereo-papillosis, bracteis minutis deltoideis, pedicellis fructiferis vix 1 mm. longis; floribus perparvis, ovario excepto 5-meris; calycis lobis triangularibus vix

1 mm. longis, pulvereo-papillosis; petalis paullo longioribus, apice acutis, pulvereo-papillosis; staminibus brevissimis, in disci margine insertis; disco crassiusculo; ovario ovoideo, biloculari, stylo crassiusculo, stigmate bilobo; baccis 3–4 mm. diametro, bilocularibus, 4-spermis; seminibus 2–2.5 mm. longis, testa rugulosa.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, *Brass 10968* (TYPE), October 1938, alt. 2750 m., common in forest openings on the lower slopes (flat branching tree 5–7 m. high; flowers green); Bele River, 18 km. northeast of Lake Habbema, *Brass 11528*, November 1938, alt. 2400 m., common in forest undergrowth (tree 5–6 m. high; flowers green).

Perrottetia traumatophylla shows some likeness to *P. nervosa* Ridl. in the few prominent primary veins anastomosing well within the margin of the leaves. The leaves, however, are not rounded at the base, the petals are longer than the sepals, the inflorescence is much longer, and the fruit is a little larger than that of *P. nervosa* Ridl. On the lower surface of the leaves, particularly near the veins, many minute punctures indicate the presence of domatia; hence, the specific name *traumatophylla*.

SABIACEAE

Meliosma Blume

Meliosma Schlechteri sp. nov.

Ramuli subangulati, apicem versus ± ferrugineo-hirsuti; foliis imparipinnatis, alternis, 3–5-jugis; petiolo rhachique 8–20 cm. longis, ferrugineo-hirsutis, pilis detergibilibus; petiolulis 5–7 mm. longis, terminali 1.2 cm. longo, hirtellis; foliolis coriaceis, oppositis, oblongo-ellipticis, 4–9.5 cm. longis, 2.6–4 cm. latis, basi obtusis vel subrotundatis leviter obliquis vel superioribus cuneatis, apice obtuse acuminatis apiculatis, acumine 3–7 mm. longo, margine integris vel apicem versus remote minuteque 3–5-dentatis, supra glabris, subtiliter reticulatis, costa plerumque pubescentibus, subtus distincte reticulatis, praecipue costa venisque breviter pilosis, axillis inter venas ac costam ± fasciculato-barbatis; venis primariis utrinsecus 7–9, supra impressis, subtus prominulis; inflorescentiis ± 30 cm. longis, divaricatim ramosis, hirtellis, floribus tantum glabris; sepalis rotundatis, glanduloso-ciliatis; petalis exterioribus obovato-orbicularibus, interioribus dorso filamentorum adnatis, utrinque in appendiculam brevem productis; staminodiis connatis; disco subannulari quam ovario glabro paullo breviore, margine irregulariter lobato, lobis subulatis.

NORTHEASTERN NEW GUINEA: woods of Kani, *Schlechter 18292* (TYPE) September 1908, alt. 1000 m.

This species is undoubtedly very closely related to *Meliosma humilis* Merr. & Perry. It differs in its practically entire and much more coriaceous leaves. It is also much less pubescent than the latter species.

RHAMNACEAE

Ventilago Gaertner

Ventilago papuana sp. nov.

Planta magna scandens; ramulis puberulis fuscis, innovationibus ± dense pubescentibus; foliis tenuiter coriaceis, late ellipticis, 4.5–12 cm. longis, 2.5–7 cm. latis, basi rotundatis, apice abrupte acuminatis, acumine 0.5–1.5 cm. longo, 0.3–0.5 cm. lato, obtuso, margine integris vel obsolete remoteque crenulatis, maturis utrinque glabris, novellis subtus puberulis, in utraque pagina dense manifesteque reticulatis; venis primariis utrinsecus 6–8 curvato-adscendentibus; petiolo 6–9 mm. longo tereti vel minute canaliculato, puberulo vel glabro; racemis 4–13 cm. longis, axillaribus atque subterminalibus, minute pubescentibus; axi hinc inde anguloso; floribus exiguis, fasciculatis, pedicellatis; pedicellis 1 mm. longis; calyce extus minute pubescente, lobis acutis circiter 1 mm. longis; petalis obovato-deltoideis emarginatis; staminibus quam petalis paululo longioribus; disco prope stylum parce pubescente, caeterum glabro; stylo bipartito basi pubescente, apice vix incrassato; fructibus immaturis usque 4 cm. longis alis inclusis, basi puberulis, ala oblonga, ± reticulatim venosa; semine non viso.

BRITISH NEW GUINEA: Lower Fly River, east bank opposite Sturt Island, *Brass 7973* (TYPE), October 1936, occasional on the ridges (rain-forest canopy liane; flowers yellow).

In some characters this species suggests *Ventilago cernua* Tul. from Rawak Island. The latter species, however, has much shorter petioles (about 3 mm. long) and fewer and somewhat more ascending primary veins. We are indebted to Monsieur R. Metman, Muséum d'Histoire Naturelle, Paris, who, previous to the outbreak of hostilities, very kindly lent us a flower and a leaf from the type of *Ventilago cernua* Tul. for comparison with our material.

Another collection which may belong to this species is *Brass 14058,* Bernhard Camp, Idenburg River, April 1939, alt. 50 m., rain-forest of flooded river plain (common large liane in forest edges). This specimen has spreading rather than appressed pubescence on the inflorescence, and is without fruits.

Colubrina Richard ex Brongniart

Colubrina papuana sp. nov.

Arbor magna; ramulis atro-fuscis, innovationibus fulvo-pubescentibus mox glabratis; foliis alternis membranaceis integris, ellipticis ad oblongis, 5–10 cm. longis, 2–5 cm. latis, basi obtusis, in apicem obtusum recurvum angustatis, maturis utrinque glabris, novellis subtus ± pubescentibus mox glabratis, penninerviis; venis primariis utrinsecus 5–7, oblique adscendentibus; petiolo 0.5–1.5 mm. longo, puberulo ad glabro; paniculis ad ramulorum apicem axillaribus, circiter 4 cm. longis, axi ramulisque puberulis ad glabratis; floribus ante anthesim glabris pedicellatis, pedicellis 1.5 mm. longis; calyce ad medium 5-fido, lobis vix 2 mm. longis, acutis, intus cristatis; petalis ½ longitudinem calycis loborum subaequantibus, margine incurvis; staminibus brevibus, probabiliter petalis subaequilongis; disco crasso 5-lobato, in margine brevissime libero; ovario in disco submerso calyci adnato, triloculari, stylo crassiusculo apice 3-lobato, lobis brevibus recurvis; fructibus depresso-globosis, leviter trisulcatis, circiter 1–1.5 cm. diametro, basi calycis patella suffultis, introrse dehiscentibus; epicarpio in sicco vix 0.4 mm. crasso, endocarpio crustaceo-sublignoso; semine compresse globoso, 1 cm. longo latoque 6 mm. crasso, testa rubra, puncticulata.

NETHERLANDS NEW GUINEA: Hollandia, *Brass 8986* (TYPE), August 1938, alt. 100 m., rain-forest (common large canopy tree; trunk spurred; bark corky-fibrous, rough; wood yellowish; flowers cream-colored; fruit orange); Bernhard Camp, Idenburg River, *Brass & Versteegh 14005*, April 1939, alt. 75 m., occasional on the lower slopes of primary rain-forest (tree 25 m. high; flowers yellow; fruit red).

BRITISH NEW GUINEA: Lake Daviumbu, Middle Fly River, *Brass 7459*, August 1936, common tree of rain-forest canopy (bark pale brown; fruit orange-colored; seeds red).

Although the general aspect of the collections suggest *Rhamnus*, on account of the thick disk and the partly inferior ovary, the plant seems to fall in the genus *Colubrina*. The valves of the fruit are coarser and firmer in texture than those of *C. asiatica* Brongn.

It is to be noted that Lauterbach, Bot. Jahrb. **57**: 326–340. 1922, does not include *Colubrina? Beccariana* Warb. in his treatment of the Rhamnaceae of Papuasia.

THYMELEACEAE

Gyrinops Gaertner

Gyrinops Ledermannii Domke, Notizbl. Bot. Gart. Berl. **11**: 349. 1932.

NETHERLANDS NEW GUINEA: 2 km. southwest of Bernhard Camp,

Idenburg River, *Brass 13672*, March 1939, alt. 750 m., rain-forest of the slopes (slender treelet 2 m. high; flowers white).

This collection seems to be a reasonably good match for the description of *Gyrinops Ledermannii* Domke, founded on a fruiting specimen of Ledermann from Northeastern New Guinea. *Brass 13672* shows a flowering branch and a young growing shoot. The leaves of the latter are 10.5–21 cm. long and 3–5.5 cm. broad, the larger ones are acuminate-caudate, the acumen being 2.5 cm. long, all are sparsely pilose beneath. This is a considerable variation from the measurements of the leaves of the type-specimen. The fascicles contain 3–6 flowers, the calyx-tube is 3 mm. long, the pistil is scarcely more than 3 mm. long, somewhat densely short-pilose, the ovary and stipe are hardly 2 mm. long, compressed obconical, the style and stigma are 13 mm. in length. The other floral characters and measurements coincide with those given in the original description.

Phaleria Jack

Phaleria subcaudata sp. nov.

Frutex magnus; foliis oppositis anguste obovato-oblongis, circiter 23 cm. longis, 7 cm. latis, petiolatis, basi obtusis vel late cuneatis, apice subabrupte longe acuminatis, acumine ± 2 cm. longo, integris chartaceis glaberrimis; costa subtus prominula; venis primariis utrinsecus 10–12 patenti-obliquis prope marginem anastomosantibus; venulis numerosis laxe reticulatis; inflorescentiis subumbelliformibus terminalibus probabiliter axillaribus; pedunculis circiter 5 mm. longis bracteatis; floribus numerosis albidis; involucri foliolis breviter ellipticis obtusis glabris; perianthii tubo infra angustissimo, apicem versus ampliato, extus glabro, intus minute parceque puberulo, ± 18 mm. longo, limbo quadrilobo, lobis 7 mm. longis obtusis margine tantum ± pubescentibus; staminibus longe exsertis, antheris ellipticis 0.6 mm. longis; stylo paullo exserto quam filamentis breviore; ovario parce puberulo; fructibus ignotis.

British New Guinea: Central Division, Kubuna, *Brass 5657* (type), November 1933, alt. 100 m., rain-forest (large straggling bush, very showy white flowers).

In foliar characters this species suggests *Phaleria capitata* Jack and *P. calantha* Gilg. It differs from the former in the larger number of primary veins, from the latter in the leaf-outline, and from both in having the perianth lobes pubescent only along the margins.

Phaleria Perrottetiana (Decne.) F. Vill. Novis. App. Fl. Filip. 183. 1880; Merr. Enum. Philipp. Fl. Pl. **3**: 131. 1923.

Drimyspermum Perrottetianum Decne. Ann. Sci. Nat. II. Bot. **19**: 38. 1843.

BRITISH NEW GUINEA: Western Division, Daru Island, *Brass 6057, 6240,* fairly common in light rain-forest (shrub 1–2 m. or more high; flowers white, fragrant; fruit red, fleshy); Lake Daviumbu, Middle Fly River, *Brass 7657,* occasional in rain-forest undergrowth (shrub or small tree 2–2.5 m. high; bark tough, fibrous; fruit smooth, red).

These specimens were determined in 1937 by Dr. W. Domke. The species has been collected previously in the Philippines and Borneo; this seems to be the first record for New Guinea. Possibly two collections from the Solomon Islands (*Kajewski 2698,* Guadalcanal Island, and *Kajewski 2237,* Bougainville Island) also belong here. The specimens show only very young buds.

Wikstroemia Endlicher

Wikstroemia venosa sp. nov.

Frutex ± 1 m. altus; ramulis hornotinis ± dense minuteque pubescentibus, annotinis fusco-purpureis glabris; foliis chartaceis vel leviter coriaceis, oppositis, lanceolatis vel lanceolato-ellipticis vel fere ovatis, 2–7 cm. longis, 1–3 cm. latis, basi late obtusis vel subrotundatis, apice acutis vel acutiusculis interdum obtusiusculis, utrinque glabris vel initio costa subtus ± pilosis; venis primariis distincte manifestis subirregularibus utrinsecus 7–10 patentibus deinde curvato-adscendentibus; petiolo brevi, 1–2.5 mm. longo pubescente; floribus viridibus vel flavis, pluribus, subspicatis vel subfasciculatis, saepissime inflorescentiis terminalibus interdum axillaribus; pedunculo 2–4 mm. longo, rhachi usque 11 mm. longo, adpresse pubescentibus, pedicellis brevissimis pubescentibus; perianthii tubo circiter 6.5 mm. longo et 1 mm. diametro, extus fere glabro, lobis 4 oblongis 2–2.5 mm. longis extus puberulis; antheris 8, linearioblongis, 1 mm. longis, filamentis brevissimis, eis seriei superioris faucem vix attingentibus, seriei inferioris paullo supra medium affixis; disci squama unica 1 mm. longa, apice biloba; pistillo 1.2 mm. longo, ovario fere glabro apice parce strigilloso, stylo 0.2 mm. longo, stigmate capitato; fructibus ellipsoideis utrinque leviter angustatis, 6–8 mm. longis, apice parce strigillosis.

NETHERLANDS NEW GUINEA: Balim River, *Brass 11667* (TYPE), December 1938, alt. 1600 m., deforested slopes, occasional on grassy banks of streams (shrub ± 1 m. high; flowers green; fruit red, fleshy); southern slopes of Balim Valley, *Brass 11612,* alt. 1700 m. (grassland shrub; flowers green). BRITISH NEW GUINEA: Central Division, Laloki River, Rona, *Brass 3577,* April 1933, alt. 450 m., on or about rocks on savannah, common (compact small tree with tough brown bark; lower leaf-surface glaucous; flowers yellow).

This species seems to be most like *Wikstroemia foetida* (L.f.) A. Gray, the leaves are firmer with a strongly marked venation, the inflorescence is spicate, occasionally subfasciculate. Possibly belonging to this species or surely closely allied to it is *Brass 3473*, Cape Prieto, Ysabel, Solomon Islands. The inflorescence here is longer-pedunculate and more loosely flowered. The genus is very much in need of critical revision.

Kelleria Endlicher

Kelleria patula sp. nov.

Suffrutex ramosissimus; caulibus vagantibus, decumbentibus; ramis erectis vel adscendentibus glabris cicatricatis; foliis alternis, inferioribus patentibus interdum reflexis, superioribus laxe imbricatis, lanceatis vel lineari-subulatis, 4–6 mm. longis, 1.5 mm. latis, obtusis, late sessilibus, convexis, 7–9-striatis, marginibus et apicibus sericeo-villosis; floribus ± 6 apice ramulorum confertis; pedicellis brevissimis pilosis; perianthio piloso, tubo subinfundibulari, 3 mm. longo circiter 1 mm. diametro, 8-venoso; lobis 1.2 mm. longis, patulis oblongis obtusis intus glabris; staminibus 4 cum perianthii lobis alternantibus, vix 1 mm. longis; faucis squamis ellipticis, discretis, basi loborum binatim inter staminum insertionem affixis; disco hypogyno nullo; ovario 1 mm. longo oblongo sessili, apice piloso, stylo 2.4 mm. longo, stigmate globoso parvo; fructibus ignotis.

Netherlands New Guinea: 11 km. northeast of Wilhelmina-top, *Brass & Myer-Drees 9806* (type), September 1938, alt. 3400 m., alpine grassland, plentiful on sandy banks of stream (bushy shrub 20–40 cm. high); *Brass & Myer-Drees 9671*, September 1938, alt. 3400 m., rather dry grassy place (very small shrub; corolla white, anthers orange-yellow; leaves grayish; twigs reddish brown).

This species differs from *Kelleria ericoides* (Hook. f.) Domke and *K. papuana* Domke in the coarser decumbent habit and the slightly larger and spreading rather than erect appressed leaves. Both the latter species have an erect habit and leaves rather stiffly erect and closely appressed.

ELAEAGNACEAE

Elaeagnus Linnaeus

Elaeagnus triflora Roxb. Fl. Ind. **1**: 459. 1821; Servettaz, Beih. Bot. Centralbl. **25**(2): 104. 1909.

Netherlands New Guinea: Balim River, *Brass 11703*, December 1938, alt. 1600 m., in a relic strip of *Castanopsis* forest (large scrambling

shrub; flowers white; fruit red, fleshy); 4 km. southwest of Bernhard Camp, Idenburg River, *Brass 13273*, March 1939, alt. 850 m., seral rain-forest (scandent shrub with yellowish flowers). NORTHEASTERN NEW GUINEA: Sattelberg, *Clemens 169, 468*, October 1935, alt. about 900 m., forest hill (scandent over trees; fruit tomato-red; flowers yellow, very fragrant).

We have not found any previous record of the presence of this genus in New Guinea, but it is to be expected as it has long since been reported from Malaysia and Australia. The specimens here cited represent the subsp. *tetragonia* Servett.

LYTHRACEAE

Rotala Linnaeus

Rotala mexicana Cham. & Schlecht. Linnaea **5**: 567. 1830; Koehne, Bot. Jahrb. **1**: 150. 1881, Pflanzenr. **17**(IV. 216): 29. 1903; Val. Bull. Dept. Agr. Ind. Néerl. **10**: 36. 1907.

BRITISH NEW GUINEA: Western Division, Mabaduan, *Brass 6536*, April 1936, a wet season ephemeral plant growing on wet soil around pools in savannah-forest.

Since Mansfeld's treatment of the Lythraceae of Papuasia begins with the statement that this family is represented in New Guinea by *Ammannia, Pemphis* and *Lagerstroemia*, it seems worth while to record this second collection (leaves both decussate and whorled) of *Rotala mexicana* Cham. & Schlecht. from British New Guinea, and also to call attention to Valeton's previously published record of this species from Merauke, Netherlands New Guinea.

Lagerstroemia Linnaeus

Lagerstroemia Archeriana F. M. Bailey, Syn. Queensl. Fl. 196. 1883; Koehne, Bot. Jahrb. **4**: 408. 1883; F. M. Bail. Queensl. Fl. **2**: 678, *t. 24*. 1900; Koehne, Pflanzenr. **17**(IV. 216): 264. 1903.

BRITISH NEW GUINEA: Western Division, Daru Island, *Brass 6239*.

The collection is a good match for *Brass 888* which Mr. C. T. White indicated as identical with *Lagerstroemia Archeriana* F. M. Bail. Koehne, in his treatment of the Lythraceae, assigned the species to section *Trichocarpidium* Koehne under the major caption, "Calyx aut ecostatis aut costis v. alis v. plicis sepalorum numero duplo munitus." The contrasting caption, "Calyx costis v. alis v. auriculis a latere complanatis tot quot sepalis munitus," separating the section *Pterocalymma*

(Turcz.) Koehne from the others, seems to us a more suitable place to look for this species. Bailey described the calyx of his plant as prominently six-ribbed; the latter is an obvious character of the New Guinean collections.

SONNERATIACEAE

Sonneratia Linnaeus f.

Sonneratia ovata Backer, Bull. Jard. Bot. Buitenz. III. **2**: 329. 1920.

BRITISH NEW GUINEA: Western Division, Daru Island, *Brass 6264*, March 3, 1936, plentiful in landward edge of mangrove forests (handsome thick foliaged tree 15–20 m. high; branches spreading, short; a few large pointed pneumatophores over 30 cm. high and ± 6 cm. diameter; thick fissured, suberose, brown bark; leaves fleshy, nerves more prominent beneath; flowers white; fruit depressed, ± 5.5 × 3.5 cm.).

This species is based on specimens from Riouw, Java, Karimon Djawa Islands, Celebes and Moluccas. To this geographical range we now add New Guinea.

Duabanga Buchanan-Hamilton

Duabanga moluccana Blume, Mus. Bot. Lugd.-Bat. **1**: 109. 1849.

NETHERLANDS NEW GUINEA: 2 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13514*, March 1939, alt. 750 m., occasional on slopes of primary rain-forest (tree 35 m. high; flowers yellow); Bernhard Camp, Idenburg River, *Brass & Versteegh 14015*, April 1939, alt. 75 m., occasional in primary rain-forest on lower mountain slopes (tree 27 m. high; fruit green). BRITISH NEW GUINEA: Palmer River, 2 miles below Black River Junction, *Brass 7289*, July 1936, alt. 100 m., river flood-plain forest (branches stiff, robust, 1.5–2 m. long; petals in bud yellow-green).

Except for slightly larger (up to 4 cm. long) and possibly more conical fruits, these collections are a good match for the Malaysian specimens of *Duabanga moluccana* Bl. in our herbarium. It is to be noted that Knuth, in separating his *D. borneensis* from this species, mentions only the difference in the size of the capsule. We have not sufficient material at hand to determine the range of variation in the size of the fruits of *D. moluccana* Bl., but we are a little wary of using such a character without other supporting differences. This is apparently the first record of the genus from New Guinea.

CRYPTERONIACEAE

Crypteronia Blume

Crypteronia Cumingii (Planch.) Endl. Gen. Suppl. **4**(2): 39. 1847; Merrill, Enum. Philipp. Fl. Pl. **3**: 139. 1923.

Henslovia Cumingii Planch., Hook. Lond. Jour. Bot. **4**: 478, *t. 16, C. f. 1–4.* 1845.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, *Brass & Versteegh 13584*, April 1939, alt. 450 m., occasional in primary rain-forest (tree 24 m. high; buds green; bark dark brown, scaly).

Although this specimen has only very young flower-buds, we are reasonably sure it represents *Crypteronia Cumingii* (Planch.) Endl., a species previously known from the Philippines and Borneo. If we have not overlooked some reference, this is the first record of the genus in Papuasia.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

THE 1938–39 EXPEDITION TO THE SNOW MOUNTAINS, NETHERLANDS NEW GUINEA

L. J. Brass

With seven plates

INTRODUCTION

The 1938–39 expedition was the third of a series undertaken by Mr. Richard Archbold, Research Associate, American Museum of Natural History, for general biological exploration on the still imperfectly known and partly unexplored island of New Guinea. The first of these expeditions[1] covered in 1933–34 a section from Hall Sound on the south coast of the Territory of Papua to the summit of Mt. Albert Edward (3980 m.), and visited the Oriomo River, between the Fly River and the border of Netherlands New Guinea. The second expedition,[2,3] in 1936–37, examined the Fly River from the coast to the foothills of the central mountain complex, and the country of the Wassi Kussa River, also in Papua. The chief objective planned for the 1938–39 expedition was a cross section of the northern slopes of the Snow Mountains, from the Idenburg River to Mt. Wilhelmina, in Netherlands New Guinea.

The Snow Mountains, the most lofty section of the high central range of the island, rise to an elevation of 5000 m. in Mt. Carstensz, and six of the peaks — the Idenburg Mts., Mt. Carstensz, Mt. Wilhelmina, J. P. Coen Mts., Prins Hendrik Mt. and Juliana Peak — are capped with eternal snow. A large lake (Lake Habbema) was known to exist at an altitude of over 3000 m. on the north fall of the range, near Mt. Wilhelmina, and on this lake it was proposed to land a party by airplane and there establish a base for operations up and down the slopes.

As early as 1912 the Wollaston Expedition had penetrated from the south coast and reached the edge of the permanent snow on Mt. Carstensz; and in 1936 Colijn had led an expedition to its summit. Mount Wilhelmina was climbed from the south side by the Lorentz-van

[1]Archbold, Richard and A. L. Rand. Summary of the 1933–34 Papuan Expedition. Bull. Am. Mus. Nat. Hist. **68:** 527–579. 1935.

[2]Brass, L. J. Notes on the vegetation of the Fly and Wassi Kussa Rivers, British New Guinea. Jour. Arnold Arb. **19:** 174–190. 1938.

[3]Rand, A. L. and L. J. Brass. Summary of the 1936–37 New Guinea Expedition. Bull. Am. Mus. Nat. Hist. **77:** 341–380. 1940.

Nouhuys Expedition in 1909, and again in 1913 by the Herderschee Expedition. In 1921 the Kremer Expedition, approaching from the north past Lake Habbema, had also reached the summit of Mt. Wilhelmina. These expeditions, all but the last, had brought back collections from high altitudes on the Snow Mountains, but, owing to the difficult conditions under which they were made, and the short time spent at the upper levels, none was very extensive. In 1920, Lam, botanist to the van Overeem Expedition, made large gatherings of plants on the outlying Doorman-top. Several expeditions had made zoölogical and botanical collections on various parts of the Idenburg River.

To carry out the work projected it was necessary to seek the aid and co-operation of the Government of the Netherlands East Indies. This was given in full and generous measure, and a joint expedition, called the Indisch-Amerikaansche Expeditie, was formed under the general leadership of Archbold. A military covering party of 56 officers and men, under the command of Staff Captain C. G. J. Teerink, was provided by the Indies Government. Doctor L. J. Toxopeus was attached as entomologist, Dr. E. Myer-Drees as forester, and Mr. Ch. Versteegh as assistant forester. The American staff consisted of Dr. A. L. Rand, ornithologist and assistant leader, Mr. W. B. Richardson, mammalogist, and the writer in charge of botanical collections. Seventy-three Dyaks from east-central Borneo were recruited as carriers and field assistants for the scientific party. The military escort had a carrier force of 30 convicts — mostly Javanese. As finally constituted the expedition personnel numbered about 200 men.

For aërial transport, Archbold provided a two-engined Consolidated P.B.Y.2 flying-boat — the "Guba" — with a crew of four in charge of Pilot R. R. Rogers. To assure the co-ordination of operations essential to an expedition of the kind, the equipment included portable radio sets by means of which the various field parties could keep in touch with each other, maintain communications with coastal headquarters, and with the airplane while in flight.

* * * * * *

The expedition yielded about 6000 numbers of plants in all, of which 69 per cent occurred above 1000 m. and 20 per cent at elevations exceeding 3000 m. With the exception of about 600 numbers from coastal localities and the Idenburg River, which Myer-Drees collected independently for Buitenzorg, these collections are deposited at the Arnold Arboretum. Before returning to Java in October, 1938, Myer-Drees assisted in general botanizing on Mt. Wilhelmina; and included in the

main collections are 602 numbers representing trees from which Versteegh took wood specimens for the Forest Research Institute, Buitenzorg.

The Pandanaceae, Ulmaceae, Pittosporaceae, Rosaceae, Geraniaceae, Oxalidaceae, Rutaceae, Meliaceae, Aquifoliaceae, Celastraceae, Sapindaceae, Rhamnaceae, Barringtoniaceae, Rhizophoraceae, and several other families represented by very few numbers have been determined by Dr. E. D. Merrill and Dr. L. M. Perry; the Theaceae and Oleaceae by Dr. C. E. Kobuski; the Myristicaceae, Monimiaceae, and Hippocrateaceae by Dr. A. C. Smith; the Musci by Dr. E. B. Bartram; and in part, the Boraginaceae by Dr. I. M. Johnston, the Selaginellaceae by Mr. A. H. G. Alston, the grasses by Mrs. Agnes Chase, and the ferns by Prof. E. B. Copeland. Numbers following a generic name in the text of this paper are the field numbers of the writer, under which collections made conjointly with Myer-Drees and Versteegh also appear. With some few exceptions, the generic names thus used are from a list of preliminary sight identifications kindly supplied by Dr. Merrill.

ITINERARY AND ROUTES

In April–June, 1938, a coastal base was established at Hollandia, a civil administration post and small settlement on the west side of Humboldt Bay, connected by monthly steamer with Makassar and Java. Then followed, between June 21 and 27, a series of four preliminary flights for the purpose of examining the country in which the inland party proposed to operate. The first aim of these flights was a reconnaissance of Lake Habbema, which, from its large size and situation among not too high ridges, proved eminently suitable for a high altitude air base. Mount Wilhelmina and its approaches were also examined at this time.

To ensure a safe retreat to the coast in the event of a mishap to the airplane, it was necessary to find a route, as short and direct as the nature of the country would allow, from Lake Habbema to the Idenburg River, and to select a site for an emergency supply base on the Idenburg. In successfully carrying out this part of the aërial reconnaissance, there was discovered, to the east of the route followed by Kremer's party, in country previously unexplored and unseen from the air, a very extensive system of heavily populated valleys that commenced little more than a day's walk from Lake Habbema and extended far north and northwest towards the Idenburg.

The northernmost of the new valleys drained to the Wal or Hablifoert River, a tributary of the Idenburg. Most of them were, however, laterals of a great central valley, to which the name "Groote Vallei" was given

by the Netherlands members of the party. About 80 km. long and up to 20 km. wide, this central valley had a bottom elevation of 1500–1700 m. and was found to be drained by the Balim (or Baliem) River, the headwaters of which were discovered by the Kremer Expedition in 1921. Flowing first west-northwest from the slopes of Mt. Wilhelmina and receiving the waters of Lake Habbema, the Balim described a wide loop to the east and southeast, then cut through the Snow Mountains in a deep gorge to join the Reiger, the main branch of the Lorentz River, which flows to the south coast.

The Grand Valley of the Balim, and many of its laterals, had been almost completely deforested up to elevations of 2300–2400 m. on the sides of the surrounding mountains. The utmost limit of cultivation was in the neighbourhood of 2500 m. Whole mountain ridges had been stripped of their original vegetation and their contours laid bare under a pale coating of grass. On these bald ridges were many village groups of gardens walled with stones, and marking their surface, in pleasing native irregularity, were the old walls which had enclosed former cultivation plots. The pock-marked effect given by sinkholes indicated that most of the country rock was limestone. In the main valley the plane flew low over numerous walled or stockaded villages and beautifully patterned gardens laid out on rich alluvial flats. Broad ditches in these gardens were in many cases full of water, for much of the valley bottom was low lying and swampy. A first estimate of 60,000 people in these, for New Guinea, highly cultivated valleys, was probably too conservative.

The usual direction flown from Hollandia on the reconnaissance and subsequent transport flights was approximately 240° for 200 km. to the Idenburg, then 220° for 100 km. to Lake Habbema or Mt. Wilhelmina. On this course, after leaving the hilly shores of Humboldt Bay, with their discontinous fringe of secondary grassland, the Cyclops Mts. were passed on their inland side and the plane flew over Lake Sentani.

Lake Sentani, beginning 10 km. from the coast, has a length of about 25 km., a width of 1–12 km., and lies at an elevation of 80 m. above sea level. From the air the lake is seen to be surrounded by hills partly covered with rain-forest but mostly by treeless grassland. Remarkably distinct lines of trees border the shores at the foot of the grassy hills and fill the gullies that score their sides. In some parts the shores are fringed with sago swamps. Off-lying valleys on the south and west sides look like dry arms of the lake. The lake carries a population of 7000 people, most of whom live in villages built on piles over the water. The grasslands are undoubtedly a secondary condition following deforestation by the natives. Clearing for gardens, the process by which these

grasslands are formed, can at any time be seen in operation on the forest edges. In the comparatively dry "winter" season of the southeast trade-winds, the fires which secure the invading grasses against the re-establishment of the original forest are almost a daily occurrence on some part of the area.

A somewhat scattered population continued westward on the line of flight for a distance of perhaps 30 km. from Lake Sentani. There, and in a parallel flat valley to the south of the lake, were extensive grassy areas, some of them secondary, others apparently patches of marshy land not suited for the growth of trees.

Beyond the disturbed area of Lake Sentani was a broad tract of low mountain country, completely forested, and carrying a very sparse population living in small villages or scattered solitary houses. Apparently of limestone, the mountains attained a fairly even elevation of perhaps 800 to 1000 m. and lay in closely parallel ridges trending east-southeast and west-northwest. When passing over them in early morning, there could be seen, when the weather was clear, two snow-capped peaks of the Central Range, far to the south. On one occasion, when flying at 3500 m. after a period of storms, Mt. Wilhelmina, with snow far down its sides and its top clear cut and icy, presented a magnificent sight, heightened in effect by a dark overcast and the blue-black of the lesser heights.

Between these still largely unexplored low mountains and the central mountain mass lies the valley of the Idenburg — the Meervlakte or Lake Plain. About 60 km. wide where it was crossed, the Meervlakte, as the name implies, is flat and swampy. Muddy tributaries loop over the plain to join the main river, which flows along the southern side, near the base of the central mountains. The Idenburg is a broad stream, winding and silt-laden, with an amazing number of cut off U-bends and often islands formed by the shifting of the channel. Out on the plain are big lagoons and areas of open grass marsh. Forests of swamp-inhabiting slender trees are conspicuous from the air and the open canopy and abundance of sago palms in more mixed forest further testify to the swampy nature of the ground. Later it was learned that even the dense closed forests are inundated to a depth of one to two meters for months on end in the season of the northwest monsoons.

The Meervlakte extends up the Idenburg for a distance of about 170 km. from the Mamberamo. Similar conditions are reported to prevail for about an equal distance on the Rouffaer River, the west branch of the Mamberamo. Probably the greater part of these areas is under water from December to May, when the rivers, dammed back by rapids on the Mamberamo, overflow their banks.

The first line of the central mountains rises sharply from the Meervlakte in a complex system of bold ridges which proved to consist of dark-coloured plutonic rocks. Except for one marshy valley draining into what is now known as Archbold Lake, areas deforested by natives, and the tops of the higher outlying peaks such as Angemoek and the Doorman-top, the ranges are forested up to high altitudes on the Snow Mountains. Practically every valley of consequence on the course from the Idenburg to the Balim carried some population. But not until Archbold Lake was passed did population have any great disturbing effect upon the forests. So far as could be seen from the air, the commencement of heavy population coincided with the change of the country rock to limestone.

The uniform reddish colour of the young leaves indicated some change, and a pronounced dominance, in the composition of the mountain forests (afterwards found to be of *Nothofagus*); for in their young-leaf colours the mixed rain-forests of lower levels presented a diversity of greens, yellows and browns, as well as reds. Above about 3000 m. on the slopes of the Snow Mts. the forests assumed a sombre hue, and soon after that long tongues of grassland, very different in appearance from the grasslands of the deforested valleys, descended in hollows from the alpine heights.

Lake Habbema lies in the outermost and shorter of two broad grassy valleys that run parallel to the axis of the range on a high, shelf-like plain. The Habbema valley is perhaps twice as long as the lake, which has a length of about 4 km., a width of 2 km., and is 3225 m. above sea level. The inner valley, in which a headwater stream of the Balim proper flows westward and the Wamena tributary eastward from an almost imperceptible divide, continues for an undetermined distance far to the west in the direction of Mt. Carstensz. The bottoms of these valleys of the high plain are flat and treeless. They contain many little pools and are drained by winding streams lined with the curious *Cycas*-like tree-ferns peculiar to high altitudes in New Guinea. There are also numerous pools on the tops of the smooth ridges that separate the two high valleys and form the rim of the Grand Valley. These ridges rise 75–125 m. above the plain, and carry shrubberies and mossy scrubs in which numerous slender conifers (*Libocedrus*) rise above the lower vegetation. There is little closed forest. From the air, cushions of golden-brown moss are conspicuous on the trees, and patches of the same colour appear in the shrubberies.

On the rugged main ridge of the Snow Mts., there was considerable low tree growth under bluffs and in other sheltered places up to an eleva-

tion of about 3900 m. The higher parts west of Mt. Wilhelmina consisted mainly of bare grey-white rock, frequently with a smooth weathered surface exhibiting a criss-cross pattern of cracks. On the summit of the strongly stratified knife-edged limestone ridge of Mt. Wilhelmina peak was a small area of permanent snow. Several small lakes and shallow ponds occurred on both sides of Mt. Wilhelmina about 1000 m. below the summit. A long narrow lake lay between two sharp ridges that formed a double crest to the range about a dozen kilometres to the east of the peak.

On one occasion the plane passed over the summit of Mt. Angemoek, an outlying, unexplored peak rising to 3950 m. a little to the west of the regular route. This peak was forested almost to the summit on the north side, while to the south it sloped down in a grassy plateau, perhaps 200 acres in extent, on which were two small ponds some 500 m. below the summit.

After the reconnaissance flights, a military detachment commanded by Lieut. V. J. E. M. van Arcken was landed on the Idenburg with carriers and stores for three months, for the purpose of establishing a river base, building canoes for use in case of an emergency, and exploring a route to the newly discovered Balim Valley. A trial landing with the airplane was then made on Lake Habbema. On July 19 began the transport flights to the lake, where, by the end of the month, 105 men, comprising scientific party and military covering party and carriers, with full equipment and food for ninety days, were landed in eleven trips.

Meanwhile, van Arcken was making his way in to the Grand Valley, where he was to be met by Teerink with a patrol from Lake Habbema. Guided by aërial photographs, notes and sketch maps made on the reconnaissance flights, and provisioned by parachutes dropped from the airplane, the two patrols met at a pre-arranged spot on the Balim River on August 13. This was a fine achievement, and an excellent illustration of the speed and precision with which exploration can be carried out with modern facilities and the efficient co-ordination of operations on land and in the air. Good contacts were established with the natives, the way prepared for work planned for the scientific party in the Grand Valley, and a land route opened up by which the highland party could, if necessary, withdraw from Lake Habbema to the Idenburg in 14 days of travel.

The month of August was occupied in collecting at Lake Habbema, and excursions were made to the slopes of Mt. Wilhelmina and down the slopes from the lake to examine possibilities for collecting and to choose sites for camps. On such excursions advantage was taken of

well defined native tracks which, ascending from the inhabited valleys, passed over the highlands in all directions and even crossed the summit of the range at an altitude of 3800 m.

September was spent at collecting camps established at 3560 m. and 3800 m. on the northern slopes of Mt. Wilhelmina. Attempts to reach the summit of the peak, extending over two weeks, were frustrated by bad weather. The highest point reached was attained by Archbold and Rand, who, approaching by the main ridge from the west, climbed through mist to an altitude of 4500 m.

Leaving a small military unit to maintain Lake Habbema Camp as a supply base, early in October the main party moved down the slopes toward the Grand Valley and established camp in high *Nothofagus*-forest at an altitude of 2800 m., five carrier hours from the lake. A subalpine type of forest dominated by *Podocarpus papuanus* Ridl., superior to any hitherto seen, extended down the slopes to 3100 m. The new camp was placed on the edge of a planted *Pandanus* grove, in which stood a well built hut roofed with bark. A sizable opening, resulting from the fall of several big old trees, had been enlarged and kept open by felling the smaller trees with stone tools and by ringbarking. The *Pandanus* (probably *P. brosimos* Merr. & Perry), called Weramo by the natives of these parts, was grown for its nutritious oily seeds. Large-seeded species of *Pandanus* are widely cultivated by the mountain peoples of New Guinea. They were seen at the head of the Fly River by the Archbold Expedition of 1936–37, and *P. Julianettii* Mart. and another species were planted very extensively in the mountains visited by the 1933–34 expedition.

On November 9 the collecting party moved down the slopes another 5½ hours, by the path that had been followed from Lake Habbema, to a camp established by Teerink at 2200 m. elevation on the right-hand bank of the Bele River, a tributary of the Balim. This was near the upper limit of permanent native habitation. Although narrow here, and very steep, the valley carried on its lower slopes an old established population of several hundred people who lived in hamlets of small round houses thatched with grass. Surrounding the hamlets and extending up the slopes to approximately 2400 m. were considerable areas of cleared land occupied by producing gardens, second growth forest and grass. Scattered gardens occurred in the tall *Nothofagus*-forest as high as 2480 m. The subsistence crop was sweet-potatoes, supplemented by sugarcane, very good bananas, cucumbers, a gourd, spinach and taro. Tobacco was also grown, and the people were rich in pigs. So great was the demand for the small cowrie shells carried by the expedition as

trade that, in the interests of the natives, who sold without regard for their own needs, the purchase of foodstuffs had to be curtailed.

During November, a new base was formed by the military party, and supplies laid down by the airplane, on the Balim River, three days' march below the meeting place of the Teerink and van Arcken patrols in the Grand Valley, and three days from the camp on the Bele. The Lake Habbema base was then abandoned. On December 5, Teerink having rejoined the scientific party with all the carriers, the Bele River Camp was in turn vacated.

For the first of the three days' march to the Balim, the route followed the east slopes of the Bele Valley. After skirting a deep limestone gorge by a climb to 2500 m. through virgin forest, in two hours the path dropped down to 2400 m. on the edge of the heavily populated slopes of the lower valley. From there on, intensively cultivated village groups of gardens, alternating with open grass and scrubby fallow lands, were traversed hour after hour. Population was equally heavy and gardens as numerous and extensive on the opposite slopes, and ahead was always the Grand Valley itself. Above the gardens on either side the forests continued in narrowing strips on the crests of the mountain ridges, beginning at first at about 2400 m., but following the ridges to 2200 m. as they dropped down to the edge of the Balim Valley. Below that only remnant clumps of primary forest, mostly of *Castanopsis* and oaks, dotted the slopes down to the rocky bed of the river. In most parts cultivation seemed to have been pushed up the slopes to the climatic limit at which, in this valley, crops could be grown. There was, however, on the upper slopes, still some activity in bringing new land under production. Where timber was available, logs piled one above another, or split stakes placed upright in the ground, were used for fencing the gardens and constructing contour works which, in conjunction with drains, were designed to control surface run-off and the resulting soil erosion. Often, however, stones were the only material available in quantity for such purposes. All these works — the destruction of the original heavy forest, the fencing, ditching, measures of soil conservation, and the carefully tilled fields — were the achievements of a people whose only implements were stone axes and adzes for cutting and sharpened sticks for digging.

At 7 o'clock on the second day, having camped at 2200 m. on the slopes of the Bele, high above the river, the party came out on the edge of the Grand Valley. A white cloud field, above which the high enclosing mountains rose clear and blue, filled most of the valley at that early hour. At 9 o'clock the clouds were entered as at 2000 m. the path swung

east away from the Bele. About this level were seen the last of the cultivated *Pandanus*, which hitherto had been conspicuous on old garden lands and in the neighbourhood of villages. At 1900 m. *Araucaria* trees, shaggy with lichens, began to loom up in the mist. Soon, on the ridges, there were many of these striking trees of the mid-mountain levels, growing in patches of primary oak and *Castanopsis* forest. In the hollows were secondary forests of a flat-topped *Albizzia*. For the rest of the day the way lay through attractive park-like country cut by streams and traversed by broad pebbly paths and narrow tracks through the grass, the ground often corrugated by old garden beds. Although scattered now, and inclined to be hostile, a heavy population once occupied this part of the valley.

The fertile and thickly populated plains of the Wamena tributary of the Balim were crossed early on the third day. Here the people were placid and cordial, and while some gathered to watch us pass, others continued digging in the rich black earth of the gardens. There were no fences. Surrounding and intersecting the sweet-potato fields were trenches, about 2 m. deep and nearly as wide, which served the double purpose of draining the land and keeping out the cherished, but always troublesome, village pigs. An hour was spent in getting the party across the Wamena — a rapid stony stream fringed with lines of tall casuarinas.

The Balim base camp was on the right-hand or south bank of the river at an altitude of 1600 m., four hours from the crossing of the Wamena. About 100 m. wide at that point, strong-flowing and deep, about a kilometre below camp the river began to fall away in rapids and break up around little islands upon approach to the gorge through which it joined the Reiger. In this narrowing lower end of the valley occurrences of sandstone were frequent, but the rock appeared to be chiefly limestone containing quantities of fossil coral. On the south side of the valley the slopes of the Snow Mts. arose to a jagged high crest of limestone cliffs, and were deforested and cultivated up to an altitude of about 2300 m. A huge erosion cut in soft yellow sandstone, and below it an extensive spoil fan extending to the river 1 km. above camp, made a conspicuous landmark. Across the river, on the north side of the valley, a limestone range, completely deforested but for a clump of araucarias, rose to an altitude of about 2400 m. A numerous population occupied both slopes and especially the bottom of the valley. The gardens of the slopes were walled with loose stones; those of the alluvial flats were drained by deep ditches and enclosed in wooden fences or walls of puddled earth.

On this part of the Balim, as in much of the Grand Valley, a species of *Casuarina* (*No. 11172*), wind-dispersed from its original habitat on the banks of streams and perhaps sometimes planted, played an important part in the domestic economy of the people as practically the sole source of fuel and wood for building. Although the species was very abundant and formed forest stands about the expedition base, *Casuarina* poles for camp construction and wood for cooking could be had only by purchase with the coveted cowrie shells. Care was taken in the preservation of the few relic trees of the original forests. For some species, protection seemed to be assured by tabu. Permission was denied to take wood specimens from their trunks, which was not surprising under the circumstances, and even the collection of herbarium material was viewed with horror by the natives who followed every activity of the expedition in the field.

Collecting at the last of this highly successful series of Snow Mountains camps was concluded with the evacuation of the last of the party to the Idenburg by air on December 20.

Only 50 m. above sea level, Bernhard Camp, the expedition base on the Idenburg, was situated on an old cut-off bend of the river about 1 km. from the foot of the mountains that rise from the southern edge of the Meervlakte. From there the way into the mountains was made easy by the explorations of van Arcken, who, with the view of facilitating the work of the scientific party, had penetrated a distance of 18 km. to the southwest and opened up a route by which an altitude of 2250 m. could be reached in 2½ days from the river. Beginning at 1800 m., camps were occupied at 2150 m., 1200 m. and 850 m. in the four months January to April. The field work of the expedition terminated at Bernhard Camp on May 10, 1939.

In the next eleven sections of this account the vegetation of the various camp localities is described in a geographical sequence, beginning with the coast and ending with the alpine heights.

Humboldt Bay

Only small collections of plants, comprising about 200 numbers in all, were made in this area. Attention was confined to the lower southeast slopes of the Cyclops Mts., the shores of the inner harbour known as Jautefa Bay, and the vicinity of Hollandia itself. A few species were also collected at Lake Sentani. The average annual rainfall at Hollandia is 2336 mm., of which 64 per cent falls in the six months November to April, and 36 per cent during the period May to October. February,

with an average of 310 mm. of rain, is the wettest month; September, with 86 mm., is the driest.

The terrain is ridgy to mountainous and both calcareous and non-calcareous rocks are present in the area. The primary vegetation cover, at the levels examined, consists of rain-forest, broken by occasional sago swamps. On the limestone ridges *Pometia pinnata* Forst. is one of the most abundant large trees in fairly luxuriant forests with a plentiful herbaceous undergrowth characterized by mesophytic ferns and especially tall-growing *Selaginella caudata* (Desv.) Spring. The other ridges carry a drier type of heavy forest in which rough-barked *Syzygium* spp., **Gordonia papuana* Kobuski, *Anisoptera 9000* and at least another dipterocarp are common trees, woody undergrowth plentiful, and the harsh fern *Syngramma pinnata* J. Sm. the characteristic floor plant. Oaks appear in the forest at an altitude of about 350 m. on the Cyclops Mts. Two hundred metres higher, mosses and liverworts are abundant on both trees and ground of tall moist forests containing many small tree-ferns (*Cyathea melanoclada* Domin and **C. pulcherrima* Copel.), and in which climbing *Nepenthes 8942* and *Cyathea biformis* (Ros.) Copel. are striking features of the undergrowth. Growing at still higher elevations, and conspicuous on the skyline, is an uncollected species of *Araucaria*.

Considerable areas of secondary grassland occur on the coastal fringe. This condition seems to obtain chiefly on the non-calcareous ridges, which have suffered more disturbance than the more fertile but generally more rugged limestone ridges. Also, the *Macaranga-Homalanthus* second growths that spring up after the destruction of primary forest on calcareous soils are more vigorous than the communities of *Commersonia Bartramia* (L.) Hieron., *Deplanchea 8975, Xanthostemon 8801,* etc., that appear on non-calcareous soils. About Hollandia township, where disturbance is comparatively recent, lalang grass (*Imperata*) has taken firm hold. On Jautefa Bay, and at Lake Sentani, are old-established grasslands dominated by *Themeda triandra* Forsk., one of the principal grasses of the dry *Eucalyptus* savannas of southern parts of New Guinea, with which occur many common southern associates, such as *Euphorbia serrulata* Reinw., *Knoxia corymbosa* Willd., *Sopubia trifida* Hamilt. and *Uraria* sp.

Seemingly long deforested slopes, touching on the bay to the northeast of Hollandia, support distinctive communities of grass and fern and also woody growths. There the red, non-calcareous, lateritic soil has a powdery texture, sets hard when exposed to the sun, and appears far

* denotes a new species, ** a new genus and new species described from this collection.

from fertile. A good part of the area carries a tangled growth of *Dicranopteris linearis* (Burm.) Underw., which is replaced on the more sterile soil by scattered tufts of *Eriachne pallescens* R. Br. and the clump sedges *No. 8802* and *Vincentia 8803*. Pure growths of *Ischaemum pubescens* Merr. cover extensive slopes. This grass would appear to follow the fern as a stage in succession and to set up conditions allowing the establishment of secondary forest. Associated in scattered order with stunted examples of second growth trees found elsewhere, and lending a distinctly Australian aspect to the fern and grass communities, are the small trees *Acacia Simsii* A. Cunn. and *Casuarina 8820*, and also shrubberies of *Myrtella 8887*. Dense pure scrubs of the *Acacia*, whose seeds germinate freely after a severe burning of the fern and grass, provide another characteristic feature of the area.

A peculiar xerophytic primary brush occupies some low coastal hills in Jautefa Bay. The hills are of raw coral limestone with a very rough surface in which are numerous pits and pockets of rich-looking though very dry red soil. In these accumulations of soil root such small trees and shrubs as *Mallotus 8844, Pittosporum ferrugineum* Ait. and *Myoporum papuanum* Kränzlin. The most conspicuous element of the brushes is the *Yucca*-like *Pleomele multiflora* Warb., which attains a height of 5–6 m. and raises its stout branches above the general level of its associates.

Bernhard Camp, Idenburg River

The cut-off bend on which this camp was situated received the waters of several creeks rising on the mountains nearby, and at its lower end was connected with the river. The outlet was a brisk hour's paddling or about 8 km. below the camp. For one-third of the distance, flood plain forests came out to the banks and ended in dense fringing growths at the water's edge. With the silting-in and narrowing of the channel from about 400 m. to 100 m. at that point, the forests began to give way to open stands of swamp-inhabiting trees and bodies of floating grass in quiet bays too deep for trees. Below the narrows the channel meandered through extensive grass marshes, dotted with low trees and containing forested islands, and then cut through a silt levee covered with a tall stand of purple-plumed wild sugarcane to join the river. The old river-bed above the upper end of the "lagoon" was almost filled with silt and so choked with marsh vegetation and encroaching swamp-forest that a canoe could not be got through to the river.

The lagoon rose and fell with the fluctuations of the Idenburg. A datum pole for observations on water level was erected by van Arcken

on July 11 and series of levels recorded up to October 18, after which regular daily records were kept until May 8. The water was at its lowest in August. September was a wet month locally, and early in October a brief flood of 8 m. occurred. November marked the beginning of the rainy season at Bernhard Camp; from November 3 to the end of the year, minimum water level was 4.5 m. and maximum 7.3 m. on the datum pole. The lowest level between January 1 and May 8 was 5.9 m., and for periods of 11 consecutive days in January, 12 in February, 22 in March and 16 in late April and early May, the level exceeded 8 m. The highest flood, in March, rose to 9 m. Absolute low level, estimated at minus 1 m., was not formally recorded. Since in this case the duration of inundation and of dry surface conditions is more important ecologically than extreme levels, the difference between absolute high and low water, whether 9 or 10 m., is not of great moment.

Rainfall records kept by the military party indicated a total precipitation of 4934 mm. between July 11 and May 8. The driest full month was August, with 259 mm., the wettest April, with 802 mm. of rain. The wettest months at Bernhard Camp coincided with the highest and most sustained floods, and the driest month with the lowest water; this denoted for the upper drainage basin of the Idenburg a seasonal rhythm which, for Bernhard Camp, could be assumed from the character of the vegetation of the lower mountain slopes, namely, a wet season corresponding with the incidence of the northwest monsoons, and a relatively dry season during the period of the southeast tradewinds.

The observations of the writer were limited to the wet season. When, from April 6 to May 10, collections were made here, the marshes were too deep in water to be sounded with a pole, and most of the flood plain forests could be traversed by canoe. At one time all but the highest ground in camp was under water, and only two other dry spots could be found out from the narrow strip of rising land that fronted the mountains. A comparison of soundings with the flood tables of van Arcken gave some idea of the depth and duration of inundation as affecting the various types of flood plain vegetation.

The plant communities of the flood plain, some of which were observed under dry season conditions on the Fly River in 1936, fell into two groups, viz. permanent marshes and semi-permanent swamp-forests, and communities inundated only in the flood season.

In the first category, in order of depth of inundation, were:

1) **Permanent grass-marsh:** Present in sluggish creeks and covering extensive areas of old riverbed as dominant of the open marshes was the

grass *Echinochloa stagnina* (Retz.) Stapf, whose long buoyant culms root on the bottom. With it were associated *Commelina 13992, Polygonum 14068* and *Jussiaea repens* L., of similar habit. *Pistia stratiotes* L. was present as a floating aquatic. Similar marshes occurred on the Fly River.

2) **Adina swamp-forest:** The clear-boled slender *Adina 13909,* averaging 25 m. in height, formed pure open forests of limited extent on ground covered to an average depth of about 4 m. by the highest flood and continuously under water for 38 days in November–December and for the 128 day period January 1 to May 8. The smooth grey trunks of the trees carried quantities of fleshy sun-epiphytes such as *Dischidia 14048, Hydnophytum* spp., *Hoya* spp. and *Cyclophorus lanceolatus* (L.) Alston. Forests of this kind covered large areas on the Fly River.

3) **Barringtonia swamp-forest:** The bushy, briefly deciduous *Barringtonia spicata* Bl. formed extensive pure stands 5–6 m. high. The highest flood inundated this forest to an average depth of about 3 m., so that in general the habitat was flooded continuously for 13 days in November, and for all but two days between January 1 and May 8. The closely related *B. tetraptera* Lauterb. forms swamp-forests in south New Guinea.

4) **Sago-swamp:** Although very extensive on other parts of the Meervlakte, forests of sago palms (*Metroxylon*) occupied but a few small areas within tall rain-forest at Bernhard Camp. The river flooded this habitat to a maximum depth of about 1 m. In the southeast season, local rains no doubt suffice to maintain the more or less swampy conditions essential for this palm. Sago-swamps occur in rain-forest throughout the lowlands and lower mountains of the island.

5) **Swampy rain-forest:** On the edge of the flood plain were patches of a rather open type of mixed rain-forest inundated by the river to depths of under 1 m. to about 1.5 m. (flooded about 50 to 98 days between January 1 and May 8). From the uneven ground surface and the presence as characteristic herbaceous undergrowth of *Hypolytrum 13974,* the amphibious fern *Microsorium pteropus* (Bl.) Copel., and *Oryza Ridleyi* Hook. f., more or less swampy conditions would appear to be maintained after the fall of the river waters. The principal trees *Campnosperma? 13963, Couthovia 14097, Parkia 13824* and *Serianthes 13970* attained a height of 30–35 m. and developed in some cases heavy prominently buttressed trunks. *Styrax 13953* and *Ardisia 13897* were characteristic of a rather open woody undergrowth, while *Pandanus peni-*

cillus Mart. and the fan-palm *Borassus 13775* figured conspicuously in the substage.

The second category included:

6) **Cane brakes:** *Saccharum spontaneum* L. (?) formed extensive brakes 8–10 m. high on the silt levees of the river, and also grew on gravel beds in creeks draining from the mountains. As peak floods inundated the levees to depths of 2.5–3.5 m., on the average they would be under water on all but two days between January 1 and May 8. Whatever plants occurred on lower banks of silt and mud were under water and out of sight during the period of observation; but species growing on old drift logs afloat in backwaters, such as *Torulinium ferax* L. C. Rich., *Fimbristylis miliacea* (L.) Vahl., *Pouzolzia zeylanica* (L.) Benn., *Jussiaea 13928* and *Abelmoschus 13777*, probably belonged to such a community.

7) **Timonius-forest:** Pure forests of *Timonius 14034*, about 25 m. high, occupied, at the lower end of the lagoon, extensive siltbeds submerged to a depth of 1.5–2 m. by the highest flood (flooded on an average 73 days, and dry 45 days between January 1 and May 8). Breadfruit trees (*Artocarpus communis* Forst.), no doubt brought there in the first place by the scattered nomadic natives of the river, were frequent marginal associates. *Pothos 13943*, climbing on the trees, was a characteristic feature. The *Timonius*-forests appeared to represent the one successional stage between cane-brakes and mixed rain-forest on the silt levees of the river.

8) **Nauclea-forest:** Pure stands of the 6–7 m. high small tree *Nauclea 14033*, remarkably like a low *Sonneratia alba* mangrove community in appearance, covered flat islands in the lagoon and sometimes fringed its banks. They grew on ground submerged to a depth of about 2.7 to 3.7 m. by the highest flood. Complete flooding was therefore the average condition from January 1 to May 8.

9) **Wormia-forest:** Plains generally inundated to a depth of 2.25 to 2.5 m. at highest flood level, and therefore under water 117 to 120 days in the period January 1 to May 8, carried distinctive mixed rain-forests in which *Wormia 14114* took a prominent part and formed nearly pure stands of considerable extent. Readily distinguished by its reddish flaky bark and large leaves, the characteristic tree attained a height of about 30 m. and a diameter of 1 m. The trees were well spaced and, there being little woody undergrowth, the forests were open underneath. Any herbaceous undergrowth they may have contained was under water

in the flood season. Strangling figs, whose great crowns rose high above the forest roof, were a conspicuous feature. *Stenochlaena palustris* (Burm.) Bedd. and *Pothos 13943* were prominent root-climbers. But the feature that impressed most, as one travelled through the forest by canoe, was the wealth of large shade epiphytes, such as *Asplenium ellipticum* (Fée) Copel., **A. pseudophyllitidis* Copel., **Goniophlebium subcordatum* Copel., *Microsorium punctatum* (L.) Copel., *Humata heterophylla* (Sm.) Desv., *Selaginella Hieronymiana* v. A. v. R. and Zingiberaceae, that crowded the tree trunks down to about 2 m. from high water mark and provided a wet season refuge for innumerable ants and other insects. *Wormia* entered the swampy rain-forest, described above, and possibly these forests also remained somewhat swampy after the floods.

10. **Fringe communities:** The *Nauclea, Adina,* and sometimes the *Barringtonia* forests present open faces to the waterways, and the trees straggle out into the open marshes. These trees also occur with an entirely different set of species in a dense fringing vegetation that hides from sight the interior of other types of flood plain forest. It is in these fringe communities, their aërial parts rising from anything up to 3 m. of water in the wet season, that the richest assortment of woody plants is found on the river plains. *Gnetum latifolium* Bl. and the magnificent red-flowering *Mucuna 13789* are abundant as screening lianes on the face of the forest. Bordering the *Wormia* type of forest, and leaning low over the water, is a continuous line of *Syzygium 13930,* up to 20 m. high. Elsewhere, much of the fringe vegetation is made up of *Kleinhovia hospita* L., *Pongamia pinnata* (L.) Merr., *Hibiscus tiliaceus* L. and *Crataeva 13910* as trees, and such scrambling shrubs as *Combretum 13786, Faradaya 13918, Loeseneriella sogerensis* (E. G. Baker) A. C. Smith, *Caesalpinia nuga* Ait. and *Flagellaria indica* L. On the lowest banks *Ficus 14036,* with large scabrous leaves, forms level thickets that stand not more than 1–1.5 m. above water at high flood and support an abundance of *Cayratia 13947,* pink *Ipomoea 13940,* spinose *Acacia 13776,* and other climbing plants.

From a few metres to about 0.5 km. in width, the strip of rising ground between the flood plains and the lift of the mountains consists of low stony ridges and gently sloping flats for the most part somewhat swampy in the wet season. Here there are pronounced changes in the character of the forest. On the flats and lower ridges, flood plain trees such as *Couthovia* and *Parkia* occur in abundance, while many species found as high as 600 m. and 800 m. on the mountains come down to the edge of the flooded ground. *Intsia 13542,* up to 40 m. high and well over 3 m.

in girth, *Terminalia 13925, Elaeocarpus 13569, Sloanea 14029* and *Duabanga moluccana* Bl. figure as canopy trees, and *Gnetum gnemon* L., *Harpullia cauliflora* K. Sch. & Lauterb., and *Garcinia 14065* as substage trees. Palms are numerous on the flats, where *Calamus* spp. and a *Korthalsia* make their first appearance, *Borassus 13775, Rhopaloblaste 13809* and *Cyrtostachys 13807* abound in the substage, and *Licuala 13744* and *Linospadix? 13774* mix in a rather plentiful woody undergrowth. The palms, a plentiful herbaceous layer of *Elatostema 13816* and *Ophiorrhiza 13812*, the local abundance of the small climbers *Freycinetia Klossii* Ridl. and *Piper 13904*, mosses on the undergrowth, and an abundance of *Pellionia 13771* and ferns such as *Asplenium acrobryum* Christ, *Polypodium damuense* Ros., *Hymenolepis mucronata* Fée, *Campium heteroclitum* (Presl) Copel. and *Vandenboschia aphlebioides* (Christ) Copel., as mesophytic low epiphytes, give an appearance of lowland luxuriance to a forest which is, however, actually poor in species.

850 M. CAMP, 4 KM. SOUTHWEST OF BERNHARD CAMP

A steep climb of three hours from the edge of the flood plain brought one to the top of the first mountain ridge at 900 m. altitude. Up to about 700 m. the slopes carried a poor type of tall dry-appearing rainforest with a thin canopy, in which *Intsia 13542, Pometia pinnata* Forst., *Shorea 14001, Serianthes 13546, Cynometra 13572, Alstonia 14013, Syzygium 14030, *Parastemon Versteeghii* Merr. & Perry, *Myristica fusca* Mgf. and *Garcinia 13570* were frequent trees below 300 m., and Cunoniaceae *13505, Endiandra 13198, Pygeum 13187, Turpinia 13532* and *Dysoxylum molle* Miq. prominent above 600 m. Oaks (*Lithocarpus 13556*) appeared at 120 m. and became plentiful above 350 m., but were nowhere abundant enough to characterize or bring about changes in the forest. The lower tree layers were poorly developed, epiphytes few, and lianes almost absent. A sparse predominantly woody undergrowth contained *Astronia 13671, Clerodendron 13474, Antidesma 13832* and *Amaracarpus 13863* as slender trees of 4–6 m., *Ixora 13448, Lasianthus 13670* and *Ardisia 13676* as shrubs, the fan-palm *Licuala 13744*, and slender *Pandanus Krauelianus* K. Sch. Only on flat places on the spurs, where the coarse ferns *Craspedodictyum Schlechteri* (Brause) Copel., *Tectaria cesatiana* (C. Chr.) Copel. and *Taenitis blechnoides* (Willd.) Sw., *Lindsaya azurea* Christ, *Selaginella suffruticosa* v. A. v. R., etc., congregated in quantity, was there any massing of undergrowth plants.

At 750 m., the level above which clouds settled over this slope of the ridge as a regular thing after the middle of the forenoon, matted surface

roots covered parts of the spurs and the ground became slightly mossy. Some well grown specimens of *Agathis 13171* attracted attention as an indication of a changing flora. Undergrowth remained sparse as ever, but numerous epiphytes appeared in the tree trops. An unexpected find was the tree composite *Olearia 13179,* a member of a genus most common in the subalpine zone, and not met with above 850 m. on these slopes or below 2600 m. on the Snow Mountains.

In an abrupt change, within 50 m. of the summit, the very mixed tall rain-forest gave place to a forest altogether different in character and composition and rapidly diminishing in height. While lower on the slopes the mist hung in the tree-tops, here it drifted through the forest to be absorbed by the thick coating of green and brownish bryophytes that covered the root-matted ground and enveloped the trunks of the trees. In places the carriers had worn the path down through 20–50 cm. of moss and peat to the underlying yellow clay. On the crest, where the largest trees were about 20 m. high and 0.5 m. in diameter, stilt-roots tented with moss were a conspicuous feature. The trees developed dense richly branched crowns and had smallish, recurved, often emarginate glossy leaves. Even when the sun shone, the forest was dimly lighted.

Although relatively poor in species, the "mossy-forest" of this 900 m. ridge exhibited most of the characters of the formation at higher altitudes on this mountain complex and on the Snow Mts., and was essentially a forest of antarctic beech. Associated with the dominant *Nothofagus 13147* were the conifers *Podocarpus imbricatus* Bl., *P. 13519* and especially *Phyllocladus 13520, Metrosideros 13149,* and a few minor species such as *Rhodamnia 13524* and *Endriandra 13678.* Scattered *Agathis* and the palm *Gulubia 13099* protruded above the canopy. Subsidiary trees, chiefly *Astronia 13312* and *Tetractomia Lauterbachiana* Merr. & Perry, extended their tops into the branches of the canopy trees and did much to exclude light from the forest. Often absent except for a few small ferns and *Argostemma 13316,* an abundant woody and herbaceous undergrowth of chiefly **Pandanus leptocaulis* Merr. & Perry, 1.5–2 m. high, *Dianella 13317* and *Mapania 13097,* developed under the somewhat broken canopy on crests and steep slopes, where subscandent *Oleandra cuspidata* Baker, *Cyathea biformis* (Ros.) Copel. and small *Freycinetia* spp. massed themselves on both ground and tree-trunks. Climbing *Nepenthes 13669* with big green pitchers, **Freycinetia pleurantha* Merr. & Perry, and especially the bamboo *Schizostachyum 13327* ascended to the upper levels. Poor for this type of forest, the epiphytic flora consisted mainly of Hymenophyllaceae and small orchids.

The 850 m. Camp lay beyond this ridge in a mountain-locked valley

dominated on the other side by a 1600 m. crest on the range on which the higher camps of this series were situated. Swampy in parts, and drained by a considerable stream named Araucaria Creek for stands of *Araucaria 13108* that occurred on its lower course, the valley bottom broadened to approximately 0.5 km. above the camp. Below camp the mountains gradually closed in and the creek became a succession of rapids, pools, and small waterfalls. The character of the forests indicated for this valley a rainfall far greater than that of Bernhard Camp and the intervening slopes. Dull, showery weather, broken by only six fine days, prevailed during the occupation of the camp from March 6 to April 15. Early morning fogs were frequent, and daily mist clouds, nearly always descending to the same level on the slopes, capped both the 900 m. and 1600 m. ridges at about 9 a.m. Often the day would end with torrential rain and strong wind from thunderstorms between 4 and 7 o'clock, followed by a steady downpour lasting far into the night. Temperature[1]: maximum (27 days) 22.5–28, mean 25, minimum (27 days) 16.5–19, mean 18 degrees Centigrade.

Rain-forests filled the valley bottom and extended up the slopes to *Nothofagus*-forest on both sides. But on the south slope, between 870 m. and 950 m. altitude, some broad ridges, at best poorly drained and in parts swampy, carried a distinctive type of forest dominated by *Agathis 13171*. The trees rooted shallowly in a compacted grey sand covered with a thin layer of peaty plant remains and living moss. A stately tree, up to 45 m. high and 1.5 m. in diameter, the older specimens standing in a mound of rotting bark scales, the *Agathis* formed a very open stand above a thin subsidiary layer of slender *Metrosideros 13291, Quintinia 13703, Campnosperma 13338* (peculiar to this forest) and *Daphniphyllum 13705,* 15–20 m. high. **Ternstroemia Merrilliana* Kobuski was a characteristic small tree in the more open parts, where *Astronia 13292, Drimys 13704* and *Pandanus stenocarpus* Solms-Laub. (?) supplied a rather abundant woody undergrowth. The ferns *Taenitis blechnoides* (Willd.) Sw., *Dryopteris viscosa* (J. Sm.) O. Ktz. and *Macroglena meifolia* (Bory) Copel. typified the ground flora, and *Hanguana 13304,* found nowhere else, occurred throughout. Other characteristic elements were root-climbing *Freycinetia* spp., *Cyathea biformis* (Ros.) Copel. and *Aeschynanthus 13300,* massed about the lower tree-trunks, and *Leucostegia pallida* (Mett.) Copel., **Humata Archboldii* Copel. and red-flowered *Dichrotrichum 13302* as low epiphytes. High epiphytes, mostly associated with cushioned bryophytes, included *Hydnophytum* spp. and

[1]Unless otherwise stated, meteorological readings were made 1 m. above the ground under a thatched roof in the various camp clearings.

the curious "ant-house" fern *Lecanopteris pumila* Bl. Like the *Nothofagus*-forest, from which many of its principal components were derived, the *Agathis*-forest, except for *Agathis* itself, was well mossed above as well as on the ground. It should probably be regarded as an edaphic subclimax of the rain-forest, which surrounded it on all sides, and in which, in this climatically wet valley, *Agathis* occurred in quantity.

Mossy to a degree seldom seen, and often retarded in their development by unfavourable soil conditions, the rain-forests presented other unusual features. One of these was the abundance of oaks (*Lithocarpus 13522, L. 13143, L. 13120*) and *Castanopsis 13521* on both the ridges and flat lands. Another oak (*L. 13466*) actually dominated the forest in swampy parts of the valley bottom, where the ground was broken by muddy pools, and scrambling bamboo combined with *Calamus* spp. and young *Pandanus* to form a prickly undergrowth difficult to penetrate. *Casuarina sumatrana? (13130)*, which, like *Agathis*, ranged up the slopes to 1200 m. and was not met with in any other locality, was conspicuous on steep ridges and sandy creekbanks.

The rain-forests attained their best expression on the deep sandy loam of river flats raised above the level of normal floods, where *Schizomeria 13117, No. 13309, Sloanea 13129, *Dysoxylum Randianum* Merr. & Perry, *Santiria 13111, Calophyllum 13122, Syzygium 13125, Hibiscus 13126, Cryptocarya 13127, Evodia Forbesii* Baker f., the oaks and *Castanopsis*, and some less important species formed the canopy layer of a well developed forest fully 30 m. in height. Most of the trees were conspicuously mossy. Mosses also covered exposed surface roots and rotting debris, while a thin layer of leaf litter lay on the ground. Young trees of the canopy species provided ill-defined second storey and substage layers enriched by the tall palms *Actinorhytis? 12966* and *Orania 13375*. High-climbing lianes, including *Calamus 13341* and several Apocynaceae, were well represented. There was a rich undergrowth, containing *Psychotria 13637, *Kibara elongata* A. C. Smith and *Codiaeum 13695* as small trees, *Licuala 13436* and *Linospadix? 13233* as palms, and an abundance of the tree-ferns *Cyathea geluensis* Ros. and exceedingly slender **C. gracillima* Copel., but chiefly characterized by herbaceous plants and ferns, such as *Procris* spp., *Elatostema* spp., *Tectaria cesatiana* (C. Chr.) Copel., *Dryopteris micans* Brause, **D. multiauriculata* Copel., *Selaginella velutina* Cesati, and at least a half-dozen species of *Begonia*. Epiphytes, both herbaceous and woody, were exceptionally abundant in association with climbing *Freycinetia angustissima* Ridl. and *Schizostachyum 13327* on the tree-trunks and on the undergrowth. Most important of these were the ferns *Arthropteris*

dolichopoda v. A. v. R., *Meringium gorgoneum* Copel., *Polypodium accedens* Bl., *P. albidosquamatum* Bl., *Goniophlebium subauriculatum* (Bl.) Presl, *Leucostegia pallida* (Mett.) Copel., *Nephrolepis Lauterbachii* Christ, **Asplenium paedigens* Copel., *A. cromwellianum* Ros., *Hymenolepis revoluta* Bl., *Lindsaya marginata* Brause and *Loxogramme subselliguea* (Baker) Alston, *Elatostematoides 13688*, *Ophiorrhiza 13059* and *Medinilla 13226*. In the tree-tops, which also carried a varied complement of epiphytes, *Polypodium enerve* Cav. and **Humata deltoides* Copel. grew half buried in moss, *Nepenthes 13232* with narrow green pitchers was common, and *Rhododendron* made its first appearance in the form of *R. 13067*, a shrub with showy reddish flowers, also found on open banks of the creek.

Throughout the lower mountains of New Guinea, there occurs on the edges of streams a community of flood-resistant small trees, alike in the horizontal arrangement of their branches, and, as a rule, with narrow lanceolate leaves. The branches of these trees may form one or more layers with a spread equal to or exceeding their height, which averages 2–3 m. As represented at Araucaria Creek, the community consists of *Ficus 13222*, *F. 13228*, *Syzygium 13223*, the clump palm *Actinophloeus 13700* and massed growths of *Boerlagiodendron 13697*, the latter an attractive shrub with narrow-palmate leaves and purplish inflorescence. Equally widespread and characteristic is an associated herbaceous community, restricted to firm banks and flood-washed points of rock, of which *Dryopteris cesatiana* C. Chr., *Lindsaya crassipes* Ros., *Dryopteris mutabilis* Brause, **D. riparia* Copel., *Selaginella Kerstingii* Hieron., *Hemigraphis 13100*, and the grasses *Pogonatherum paniceum* (Lam.) Hack. and *Isachne micrantha* Merr. are the most important local species. *Impatiens 13066* produces striking displays of salmon-pink flowers on the gravel beds.

Good examples of rain-forest succession occurred on the flood banks of the creek. As pioneer on beaches of gravel and sand, *Saccharum spontaneum* L. formed brakes up to 8 m. high, in which climbing *Cissus* spp. and *Mikania cordata* (Burm. f.) B. L. Rob., the shrubs *Otanthera 13063* and *Clerodendron 13062*, and small trees *Pseudopipturus 13078*, **Parasponia simulans* Merr. & Perry and *Breynia 13077* appeared as the first woody plants. The quick-growing small softwood trees *Saurauia 13265*, *S. 13394*, *Wendlandia 13284*, *Schuurmansia 12766*, *Dammaropsis Kingiana* Warb. with leaves 75 cm. long and 50 cm. broad, and the magnificent tree-fern *Cyathea contaminans* (Wall.) Copel. played a prominent part in succeeding stages, which culminated in a 25 m. stand of *Homalanthus 13268* and *Albizzia 13141*. Ground societies of *Nephro-*

lepis hirsutula (Forst.) Presl, *Dryopteris unita* (L.) O. Ktz., *Elatostema* spp. and the orchid *Spathoglottis 13080* were well developed in open parts of the young forest. *Macaranga,* one of the principal genera of rain-forest "second growth" trees, was represented by only one species, and that of minor importance.

1200 M. CAMP, 6 KM. SOUTHWEST OF BERNHARD CAMP

From this camp one looked up to the 1600 m. crest which has already received mention, and down into the valley of Araucaria Creek. The country sloped sharply in well defined spur ridges separated by ravines with sides so steep as to be somewhat unstable. Although 350 m. higher in the mountains, rainfall was probably not so great, and certainly there was less mist and fog than in the valley of Araucaria Creek. Temperatures, recorded for 12 days between February 11 and March 3: maximum 20.5–23, mean 22, minimum 15–16.5, mean 16 degrees Centigrade.

Here the oaks (*Lithocarpus 12521, L. 12569, L. 12589, L. 12598, L. 13102*) and *Castanopsis* appeared in their true character as the constituents of practically pure forests on the broader ridge crests. About 25 m. high, with slightly spurred greyish trunks sometimes surrounded by coppice shoots, the oaks grew well apart and formed a rather thin canopy. In spite of abundant illumination, subsidiary and substage trees were few. Slower to decay than those of most rain-forest species, the leaves of the canopy trees formed a rustling ground litter. The distinctly dry appearance of the forest was accentuated by the scarcely mesophytic aspect of the fern *Syngramma Hookeri* C. Chr., which characterized the sparse undergrowth, the fleshy small twiners *Dischidia 12863* and *Hoya 12845,* which found support on undergrowth and coppice shoots, and the common low epiphytes *Vittaria ensiformis* Sw., *V. elongata* Sw., *Oleandra Werneri* Ros. and *O. cuspidata* Baker. There were few high epiphytes, and usually only one canopy climber — *Dimorphanthera 12856.*

Oak-forest was, however, a rare development. The constituents ranged up and down the spurs in the prevailing rain-forest, showing preference for the crests, which, it might be mentioned, often were under mist when the ravines were clear of cloud. It was on the crests that *Agathis* reached the upper limit of its range at 1200 m.; *Phyllocladus 12523* and *Podocarpus imbricatus* Bl. descended to 1100 m. from the beech-forests and were common in places where beds of moss and surface roots covered the ground, and *Nothofagus 11963* assumed prominence at about 1400 m.

Exceptionally rich in tree species, woody and herbaceous under-

growth, lianes and epiphytes, the rain-forests of this mountain slope were the finest encountered on the expedition. On ridge tops and stable slopes, trees 35 m. high and often 1 m. in diameter formed a forest open in character under the canopy. There was considerable moss on the lower tree-trunks and on the abundant undergrowth of the ravines, and masses of bryophytes, mostly brown in colour, were conspicuous in the tree-tops. Where the rubbly soil of immature slopes afforded insecure roothold for large trees, the effects of damage by soil movement were seen in the irregular canopy and frequent openings filled with impenetrable tangles of *Calamus 13015* and *Schizostachyum 12825*.

In the rain-forests were many species common at 850 m. and even down to the plains of the Idenburg, but appearing not to extend much above this altitude. Mingled with these, and species of restricted altitudinal range, were others, especially ferns, which made their first appearance here but reached the peak of their abundance 500 m. higher on the mountains. Most of the bryophytes, ferns, and orchids of the tree-tops occurred in the mossy beech-forests of higher altitudes. Palms and Pandanaceae were less in evidence and showed a slight decrease in species as compared with Araucaria Creek, and few representatives of these groups occurred in both localities. Nine species of palms, including three of *Calamus*, a very common fan-palm (*No. 12852*) with large fruit of a bright orange colour, but only one tall species (*Actinorhytis? 12966*), were found between 1100 m. and 1500 m., as compared with ten from all types of forest at the lower camp. *Pandanus* was represented by five species and *Freycinetia* by four, as compared with five of each at the 850 m. Camp. The only large *Pandanus* was *P. penicillus* Mart., and only *P. limbatus* Merr. & Perry, gregarious in open places, occurred in any abundance. In *F. percostata* Merr. & Perry and *F. Archboldiana* Merr. & Perry, *Freycinetia* provided two of the most conspicuous large climbers of the forest.

An interesting feature of these forests, a feature which was to become more pronounced at higher altitudes, was the prominence of *Syzygium* (9 species collected) and Lauraceae (5 species) as trees of the canopy layer. *Syzygium 13018, S. 12543, S. 12548, Cryptocarya 12549, Endiandra 12530* and *Litsea 12520*, with *Schizomeria 12763, Podocarpus 12787, Calophyllum 12518, *Myristica Brassii* A. C. Smith, *M. Buchneriana* Warb., *Albizzia 12575, *Ilex Versteeghii* Merr. & Perry, *Elaeocarpus 13107, Terminalia 13009, Hibiscus 12978, Gordonia papuana* var. *montana* Kobuski, **Adinandra Brassii* Kobuski, *Platea 12554, Santiria 12546* and *Halfordia papuana* Lauterb. supplied much of the tree stocking; minor species included *Grevillea 12588, Ceratopetalum 12516* and

Galbulimima 12572, of interest for their Australian affinities. A subcanopy layer, best developed on unstable slopes and mainly of subclimax species, contained in addition to lowland elements such as *Erythroxylum ecarinatum* Burck. and *Sterculia 12765*, *Aristotelia 13016* and *A. 13024* also found in oak-forest, and *Xanthomyrtus 12971* as an accession from the beech-forest.

High-climbing lianes included, besides *Freycinetia* and *Schizostachyum*, *Mussaenda 12877*, red-flowering *Mucuna 12945*, *Morinda 13012*, *Ficus 13019* and *Dimorphanthera 12763A*, the last a white-flowering species of a mountain genus which made its first appearance on the open banks of Araucaria Creek. A very mixed woody undergrowth, 1–5 m. high, contained *Ixora 12860*, *Garcinia 12778*, *Anomopanax 12780*, *Ardisia 12812*, numerous tree-ferns (*Cyathea melanoclada* Domin, **C. pulcherrima* Copel., **C. gracillima* Copel.), and in the ravines *Cyrtandra 12776*, *C. 12920*, *Lycianthes 12907*, *Medinilla 12944* and *Poikilogyne 12981*. *Musa 12962* was conspicuous in ravines, where luxuriant herbaceous growths were characterized by *Dryopteris novoguineensis* Brause, **D. multiauriculata* Copel., *D. micans* Brause, *Leptopteris alpina* (Baker) C. Chr. var. *major* Ros. and *Tectaria decurrens* (Presl) Copel. as large ferns, *Elatostema 12946*, *Begonia* spp., *Pellionia 12936*, *Alocasia 12851*, *Homalomena 12972*, *Pentaphragma 12904* and Zingiberaceae and contained *Balanophora 12991*, commonly parasitic on the roots of several flowering plants. Numerous orchids associated with such ferns as *Asplenium scandens* J. Sm., *A. cromwellianum* Ros., *A. nidus* L., *Polypodium accedens* Bl., *P. diaphanum* Brause, *Nephrolepis Schlechteri* Brause, *Grammitis subrepanda* (Brause) Copel. and *Humata kinabaluensis* Copel. as low epiphytes, and *Aglaomorpha novoguineensis* (Brause) C. Chr. and climbing Araceae were abundant as higher epiphytes. The flora of the tree-tops included such diverse elements as *Sericolea 12862*, *Fagraea 12980* and *Ficus 12906* as trees of 10–15 m., the shrubs *Exocarpus Pullei* Pilg. and *Pittosporum Ledermannii* E. Pritzel, and on mossy branches the ferns *Oleandropsis ferrea* (Brause) Copel., *Holcocorus bisulcatus* (Hook.) Copel., *Ctenopteris eximia* Copel., *Humata Werneri* Copel., *Macroglaena Schlechteri* (Brause) Copel., *Davallia trichomanoides* Bl. and *Meringium rubellum* (Ros.) Copel., showy *Dendrobium* spp. and other small orchids.

(*to be concluded*)

JOURNAL

OF THE

ARNOLD ARBORETUM

VOL. XXII JULY, 1941 NUMBER 3

THE 1938–39 EXPEDITION TO THE SNOW MOUNTAINS, NETHERLANDS NEW GUINEA

L. J. BRASS

Concluded from page 295

1800 M. CAMP, 15 KM. SOUTHWEST OF BERNHARD CAMP

The 1600 m. crest of the steep-sided range that paralleled the valley of the Sahoenari River to the south and fronted the Meervlakte to the north was reached in two hours from the 1200 m. Camp. From there, seven hours of heavy travel along the top of the range, through mossy beech-forest that changed little in character but grew increasingly rich in species, brought one to the 1800 m. Camp. From this position views were had of the Idenburg, winding over its great plain 1750 m. below, and of range after range of high mountains piling up to the south and southeast.

Occupied by the collecting party from January 7 to February 1, this camp was, however, virtually in the clouds, and the few glimpses obtained of its surroundings were either very early in the morning, before the mist rose, or late in the afternoon, when the mist that had enveloped the ridge most of the day would sometimes disperse for the night. Light driving rain, becoming heavier as the day wore on, accompanied the mist, and severe rain squalls from the north, that uprooted trees left standing in the camp clearing, were all too frequent at night. Most of the mist was from clouds that rose rapidly from the Meervlakte with the first stirring of the light northerly wind which prevailed at that season. When the wind veered to the southeast a counter downward movement of mist was noted to take place in the afternoon. Warm fogs, which brought forth swarms of Lepidoptera

and other insects, sometimes rose from the Meervlakte at night. Temperature: maximum (20 days) 17–20.5, mean 18.5, minimum (21 days) 12–13.5, mean 13 degrees Centigrade.

Forests of *Nothofagus 11963,* about 25 m. in average height, occupied the summit of the range and followed the spur ridges down to at least 1550 m. on the southern slopes. But on the very steep northern face of the range, where there were no prominent spurs, and where the clouds, pushed up by air currents from the Meervlakte, maintained a higher level, they gave way to rain-forest not far below the summit. Other trees of the canopy layer included *Phyllocladus 11931* with fetid wood, **Calophyllum congestiflorum* A. C. Smith, which provided a good green firewood, and particularly *Weinmannia 11908*, which in parts could be called co-dominant. In *No. 11860* and *No. 12017,* the Cunoniaceae also figured prominently in the subsidiary tree layer, with **Metrosideros Pullei* Diels var. *parvifolia* White, *Quintinia 11856, Tetractomia Lauterbachiana* Merr. & Perry, and less commonly *Fagraea 12133,* Araliaceae *11855* (also epiphytic) and ***Archboldiodendron calosericeum* Kobuski, the latter a striking tree with silver-pubescent leaves. Massed on the lower tree-trunks were climbing *Cyathea biformis* (Ros.) Copel., *Freycinetia laterifolia* Ridl., **F. erythrospatha* Merr. & Perry and *Pothos 12100,* while *Tecomanthe 12002,* with very large pink flowers, occurred as a canopy liane. Characteristic of the thin undergrowth developed under dense shade were the little tree-ferns *Cyathea perpelvigera* v. A. v. R. and *C. melanoclada* Domin, slender Araliaceae, *Medinilla 11878* embedded in moss, and such small herbs and ferns as *Argostemma 11892, Burmannia 11889, Lindsaya marginata* Brause, *Grammitis knutsfordiana* (Baker) Copel., and saprophytic *Corsia 12120.* The chief wealth of these forests was, however, in their epiphytic flora, which included most of the shrubs and ferns and practically all of the numerous orchids. Most important in a list of over thirty woody epiphytes were Araliaceae (4 spp.) and Melastomataceae (2 spp.), growing near the ground, and *Vaccinium 12105, Rhododendron 11876, R. 12001, Drimys 12006, Rapanea 12360, Sericolea 12418,* Myrtaceae *12057, Hydnophytum 12111,* and scandent *Lucinaea 11858, Psychotria 12299, Alyxia 12303* and *Nepenthes 11900* at middle and upper levels. The few flowering herbs other than orchids included several Zingiberaceae. Notable among a host of ferns were *Plagiogyria tuberculata* Copel., *Oleandra Werneri* Ros., **O. crassipes* Copel., *Polypodium plebiscopum* Baker, *Calymmodon mnioides* Copel., *C. atrichus* Copel., *Dryopteris Lauterbachii* Brause, *Sphaerocionium pilosissimum* (C. Chr.) Copel., and *Macroglena meifolia* (Bory) Copel. at low to

middle levels; *Humata kinabaluensis* Copel., *Grammitis interrupta* (Baker) Copel., *Polypodium plebiscopum* Baker, **Amphipterum humatoides* Copel. and *Pleuromanes pallidum* (Bl.) Copel. occurred in the tree-tops.

Small openings made by landslips and windthrows, and the rest and camp clearings of the natives who occasionally visited the range from the Sahoenari Valley, carried secondary communities very different in the main from those of disturbed areas in rain-forest. Appearing early, with clumped *Riedelia 11893* and *Dianella 12003*, were small shrubs such as **Eurya gracilipes* Kobuski and *Medinilla* spp., scrambling *Palmeria Fengeriana* Perk., *Nepenthes 11900*, *Lycopodium cernuum* L. var., **Sticherus venosus* Copel. and **Hicriopteris astrotricha* Copel. Later the small-leaved slender trees *Rapanea 12106* (also in forest undergrowth), *Drimys 11857*, *D. 12149*, and to some extent *Rhodomyrtus novoguineensis* Diels and *Melastoma 12154* formed dense stands 3–4 m. high. Forest stands of chiefly *Eurya Groffii* Merr. (?) and *Quintinia 12061*, 10–12 m. high, developed before the return of the climax species to dominance. Several probable intruders from rain-forest, e.g. *Homalanthus 12058*, *Breynia 12300* and **Pandanus actinobotrys* Merr. & Perry, occurred in the larger openings.

Even on the cloud-shaded south slope of the range, rain-forest ascended the ravines to within 50 m. of the summit. At about 1500 m. on these slopes *Lithocarpus 11971*, *L. 11981*, *Castanopsis 11969* and *Engelhardtia 11916*, the latter an associate of the oaks in most localities, appeared as common trees. Included in 40 to 50 species of rain-forest canopy trees collected at altitudes down to 1500 m. were about fifteen of *Syzygium* and five Lauraceae. Most common were *Syzygium 11935*, *S. 11978*, *Garcinia Schraderi* Lauterb., *Cryptocarya 11911*, *Ficus 11921*, *Astronia 11937*, *Elaeocarpus 11939*, *Laurac. 11968*, **Vavaea Archboldiana* Merr. & Perry and **Acronychia goniocarpa* Merr. & Perry. Characterizing the very luxuriant undergrowth developed in the bottoms of ravines were *Saurauia* spp. (3), *Cyrtandra* spp. (6), *Elatostema 12029*, *Ophiorrhiza 12251*, *Begonia* spp. (4), Zingiberaceae (6), and a complement of ferns unequalled for variety or abundance in any other habitat or locality on this range or on the Snow Mountains, e.g. *Cyathea* spp. (5) including **C. horridula* Copel. and *C. Rosenstockii* Brause, **Marattia coronata* Copel., *Leptopteris alpina* (Baker) C. Chr. var. *major* Ros., *Athyrium acrocarpum* (Ros.) Copel., **A. latilobum* Copel., *Vandenboschia maxima* (Bl.) Copel., *Dryopteris canescens* (Bl.) C. Chr. var. *novoguineensis* Brause, **D. vestigiata* Copel. and *Orthiopteris minor* (Hook.) Copel. Essentially of ferns, the abundant low epiphytic

flora included *Mecodium Reinwardtii* (v.d.B.) Copel., **Pleuromanes retusum* Copel., *Goniophlebium demersum* (Brause) Copel., *Lindsaya marginata* Brause, *Asplenium cromwellianum* Ros. and *A. ellipticum* (Fée) Copel. Although poorer in species, the tree-top flora agreed with that of the adjacent beech-forests.

Of approximately 100 species of ferns, including 17 Hymenophyllaceae, collected in this camp locality, considerably more than half were found between the 1750 m. and 1600 m. levels in one rain-forest ravine. The beech-forests were rich in Ericaceae (about 8 species) and Melastomataceae (about 7 species). Two of four species of palms, *Calamus 12174* and *Ptychandra? 12119*, entered the beech-forests. *Freycinetia* was represented by four prominent species (3 in beech-forest), and *Pandanus* by four species of which three entered at least the edges of the beech-forest.

2150 M. CAMP, 18 KM. SOUTHWEST OF BERNHARD CAMP

This camp, where botanical collections were made from February 1 to 10, stood on the scrubby point of a very narrow wind-swept bluff 100 m. high, that broke the crest of the range two hours' journey beyond the 1800 m. Camp. In another kilometre the range rose to 2250 m. in a small peak, then dropped away as it continued westward toward Mt. Angemoek. A magnificent panorama from the point of the bluff took in a sweep of about 230 degrees, embracing Mt. Wilhelmina, the Cyclops Mts., and almost the entire valley of the Idenburg from the western end of the Gauttier Mts. to near the border of Northeastern New Guinea. Below, in the secluded V-shaped valley of the Sahoenari, on slopes largely deforested and grass-grown from about 1400 m. down to the river at approximately 1000 m. elevation, were the villages and gardens of a rather numerous population.

General weather and cloud conditions were similar to those experienced at the 1800 m. Camp. But on the exposed point of the bluff the wind attained a greater velocity at night, and, until late in the morning, up draughts and cross currents often maintained a sunlit opening when below and on all sides were swirling clouds of mist. Standard shade temperature rose as high as 26.5° in camp, while in the forest, less than 100 m. away, warm clothing was necessary for comfort at any time of day. Temperature: maximum (7 days) 20.5–26.5, mean 23, minimum (7 days) 11.5–12.5, mean 12 degrees Centigrade.

Rain-forests like those of the previous camp locality, but with a diminished undergrowth and fern flora, occupied the ravines up to an alti-

tude of 2000 m. more or less. Prominent in the rain-forest and in transition beech-forest was the very tall **Pandanus brosimos* Merr. & Perry, resembling the species planted for its seeds by the natives of the Snow Mountains, and here in some cases bearing marks of native ownership.

More massive at this altitude, and averaging 15–20 m. in height except in the immediate vicinity of the bluff, the beech-forests were composed of *Nothofagus 12453* and *N. 12675*, with *Weinmannia 11908*, *Phyllocladus 11931*, and the hitherto unencountered conifer *Dacrydium 12659* associated as common though relatively unimportant canopy trees. Prominent as subsidiary trees, and largely replacing the species of the previous camp locality, were *Xanthomyrtus 12452* and *X. 12631*. A scrambling bamboo (*No. 12662*), present in small quantities down to 1600 m. on the crest of the range, filled the forest and practically excluded other undergrowth above the 2200 m. level.

On the crest and sides of the exposed point of the bluff the forest degenerated into a very dense heavily mossed scrub of tough trees and shrubs 2–3 m. high, comprised of *Nothofagus 12453*, here flowering as a shrub, and the two *Xanthomyrtus* spp. and *Mearnsia cordata* White & Francis from the adjoining tall forest, and also containing an abundance of such second growth elements as *Rapanea 12450*, *Drimys 12629*, *Quintinia 12194*, *Kania 12628*, *Sericolea 12637* and **Ternstroemia sphondylophora* Kobuski.

Old rockslides on the face of the bluff carried, in association with *Sphagnum sericeum* C. M., a cover of *Sticherus hirtus* (Bl.) Copel., *Gleichenia peltophora* Copel., *G. circinnata* Sw., *Hicriopteris arachnoides* (Hassk.) Copel., *Dipteris conjugata* Reinw. and *Lycopodium 12460*, in which grew the whipstick *Rhododendron 12445* and other small trees and shrubs. Lichens and the mosses *Campylopus umbellatus* (W. Arn.) Bartr. and *Dawsonia limbata* Dix. preceded the ferns on newly disturbed areas, and the scrub community followed the ferns.

With the exception of the ferns, of which only *Dipteris conjugata* was found elsewhere, most of the plants mentioned as characteristic of the open habitats and low vegetation of the bluff were found in beech-forest in other localities and may be considered as belonging to this type of forest. Plentiful also, and of interest as an example of aberrant altitudinal distribution, was subalpine *Libocedrus 12190*, growing to a height of 15 m. on the edges of old rockslides and in the forest on very steep rocky slopes. *Rhododendron 12442*, of the scrubs, appeared identical with a species abundant at Lake Habbema and on the slopes of Mt. Wilhelmina, and some associated *Vaccinium* spp. will probably prove to be subalpine.

BALIM RIVER, 1600 M. CAMP

The collecting party worked here from December 7 to 20. This was at the turn of the seasons. Afternoon thunderstorms brought frequent rains, and many gardens were being dug in preparation for the main sweet-potato planting of the year. While doubtless bringing sufficient rain to sustain the growth of crops, the southeast tradewinds nevertheless had a pronounced drying effect in this deforested valley. Almost daily in late December the trades still blew up the valley with force after 9 a.m., and it was noted that most of the native villages occupied positions in depressions or behind sheltering groves of Casuarinas. Fogs, which had been observed from the mountains to form a low cloudbank in the valley, often lay over the bottom lands very early in the morning, and, breaking up over the valley and rising on the slopes as the day warmed and the wind rose, re-formed on the mountainsides, about the upper level of cultivation, in the middle of the forenoon. Temperature: maximum (8 days) 21–29.5, mean 25.7, minimum (8 days) 13.5–15.5, mean 14.7 degrees Centigrade.

Relics of the forests which, prior to the advent of man with his stone tools and fire, undoubtedly occupied the whole of the valley apart from marshes and occasional rock-faces, survive on an incalculably small area at the present time. No more than 1 per cent. of the parts now inhabited are actually under crop. An estimated 20 per cent. is wooded with secondary forest, while the remainder consists of open grasslands and, in parts of the valley, considerable tracts of open marsh.

In no part of the Grand Valley was destruction of the forests more complete than in this camp locality near its lower end. However, from the few relics of the former vegetation which existed in this particular part, and the more numerous and extensive areas of primary forest of the type encountered between here and the Bele River, it would seem that very extensive forests of oaks and *Castanopsis* once clothed the ridgy terrain of the valley bottom and extended up the slopes to elevations of approximately 2000–2200 m. The upper limit of deforestation and cultivation lay in beech-forest at about 2400 m. Not a single patch of primary rain-forest survived in any part of the valley traversed by the expedition. But from the presence of scattered trees such as *Cedrela Toona* Roxb. var. *australis* F. v. M. and *Ficus* spp., the important part played in secondary communities by rain-forest species, and furthermore, the strong representation of rain-forest elements at much higher elevations in the branch valley of the Bele River, it would seem safe to conclude that forests of this type formerly covered the rich

alluvial plains that occupy a large part of the valley bottom and reached far up the slopes in ravines and the valleys of tributary streams. The trees of the primary rain-forest that have survived possibly did so by virtue of their ability to reproduce themselves in more or less open situations on the banks of streams, in waste corners, and even on stone piles in the gardens.

In the light of recent explorations in the three political territories, it can be said that, in the mountains of New Guinea, man follows the oaks. For it is in the cool, healthy, now grassy mid-mountain valleys, where the oak-*Castanopsis* forest attains a massive development, that the teeming tribes of the far interior, the greatest concentrations of population on the entire island, have been discovered during the last decade.

Isolated small clumps of *Castanopsis 11702,* which contained also *Lithocarpus 11177* and *L. 11180* at elevations above 1750 m., occurred here and there on the grasslands which occupied all but a small part of the valley in the neighbourhood of the Balim Camp. **Celtis similis* Merr. & Perry and *Podocarpus 11187* grew in one patch, and a striking group of *Araucaria 11175,* sparsely foliaged and infested with lichens, stood across the river from camp. Most important of the forest remnants in respect of area was a "gallery" strip on the banks of a foothill stream. This consisted of a pure stand of *Castanopsis* 10 m. high, thick-boled and with spreading branches, under which, as in more extensive forests of the kind passed through on the journey down from the Bele, **Humata mecodioides* Copel. formed a dense patched ground cover. An exceptional wealth of other semi-xerophytic ferns included *Polypodium plebiscopum* Baker, gregarious on the ground, *Nephrolepis cordifolia* (L.) Presl and *Davallia trichomanoides* Bl., on both trees and ground, and the epiphytes *Vittaria zosterifolia* Willd., *Grammatopteridium costulatum* (Cesati) C. Chr., **Davallia tenuisecta* Copel. and *Drynaria rigidula* (Sw.) Bedd. A sparse undergrowth of slender treelets included **Eurya pluriflora* Kobuski and *Pittosporum ramiflorum* Zoll.

Owing perhaps to climatic influences or the constitutional limitations of the second growth species, or both, forest regeneration at this altitude and the resistance offered to invading grasses are much less vigorous than on the more tropical lower slopes of the mountains and on the humid lowland plains. This is especially true of the oak-*Castanopsis* forest. It is on the well drained soils formerly covered by forest of this type that the effects of human disturbance in modifying movements of progress and regress in the impact of the grasses with the

secondary forest communities is most pronounced, and the hold of the grasses in consequence most secure. Most of the secondary forest of the Balim Camp area occurs on the relatively small areas of moist alluvial soil, places reserved by selection as desirable for its preservation for shelter and timber supply, patches of very stony or sandy soil no longer suitable for cultivation, and areas remote from present day habitations.

Slowly, when relieved from disturbance by shifts or local decreases in population, the woody second growths gain ground and set up conditions which would in time permit the return of the original forest trees. This process is rather well advanced in parts of the valley in which, if one may judge from the ruins of stone walls and the pattern of garden beds still evident on the ground, population was as heavy as it is in the Balim Camp area today. Firing of the grass in hunting drives and to attract game to fresh feed on burnt areas, a potent factor in maintaining man-made grasslands in some regions, perhaps seldom takes place even in heavily populated parts of this valley. It appears that hunting is not a regular occupation of the people. They have few dogs to assist in the chase, and in the absence of grassland wallabies (*Macropus*) and bandicoots (*Isoodon* and *Peroryctes*) there is nothing to hunt except an occasional escaped pig. Most grassfires might therefore be attributed to the propensity of the New Guinea man to burn for the sake of burning, an inclination which, through considerations of personal safety or respect for the property rights of neighbours, is perhaps seldom indulged in beyond the territorial boundaries of the community. Lands weakly held by scattered peoples will, in consequence of this combination of circumstances, for a time stay more or less undisturbed and begin to revert to forest. But almost certainly, while population in the valley maintains its present level, these vacant lands, enriched by young forest or by the rank grass growth of years, will be reoccupied, and the valley of the Balim will remain largely a valley of grass.

When a grassland garden is abandoned after one or more seasons, it returns to grass. In the Balim Camp area the principal species that institute the reversion are *Digitaria pruriens* (Fisch.) Buse and *Setaria geniculata* (Lam.) Beauv., followed by *Ischaemum pubescens* Merr., on soils of the slopes. On moist flats *Ischaemum digitatum* Brongn. early takes possession, and the older growths consist of rank stands of this species, *Apluda mutica* L., and 2 m. high thickets of *Phragmites Karka* (Retz.) Trin., *Saccharum spontaneum* L. and *Miscanthus japonicus* (Houtt.) Anders., with which are associated *Cudrania 11807,* forming large clumps or scrambling on Casuarinas, *Rhamnus javanicus* Miq.,

Desmodium 11799 and *Rubus rosaefolius* Sm. Tall stands of *Pennisetum macrostachyum* (Brongn.) Trin. often occupy very stony ground. *Imperata cylindrica* (L.) Beauv. is plentiful on new and old grassland on all types of soil.

About 60–80 cm. high, the dominant grasses of the old-established grasslands of the slopes are *Germainia capitata* Bal. & Poitr., *Ischaemum pubescens* Merr., *Imperata cylindrica* (L.) Beauv., *Andropogon intermedius* R. Br., *Sorghum nitidum* (Vahl) Pers., *Apluda mutica* L. and *Pollinia leptostachys* Pilg. Smaller mostly annual grasses include *Andropogon brevifolius* Sw., *Eragrostis distans* Hack., *Dimeria falcata* Hack., *Aristida Cumingiana* Trin., *Sacciolepis contracta* (Wight & Arn.) Hitchc. and *Isachne globosa* (Thunb.) Ktze. Among common herbs and small woody associates are *Euphorbia serrulata* Reinw., *Spilanthes 11626, Wahlenbergia gracilis* A. DC., *Hedyotis 11628, Halorrhagis 11629, Crepis japonica* Benth., *Cassia mimosoides* L., *Xyris 11721, Borreria 11737, Uraria lagopodioides* (L.) Desv. and *Osbeckia chinensis* L. Common shrubs are yellow *Rhododendron 11694*, originally of forest openings, and *Melastoma 11712*.

Only distant views were had of the large marshes of the valley. Representatives of this flora, inhabiting drainage ditches, pools and wet fallow land, included *Leersia hexandra* Sw., *Polygonum* spp. (3), *Hygrophila 11673, Hydrocotyle 11790, Alternanthera sessilis* (L.) R. Br., *Carex 11791, Scirpus 11804, Jussiaea 11792, Smithia 11651, Echinochloa crusgalli* (L.) Beauv. and *Limnanthemum indicum* Thw.

Under primitive conditions *Phragmites, Saccharum, Miscanthus, Pennisetum* and *Imperata*, wind-dispersed grasses of wide distribution in New Guinea, doubtless occupied limited open habitats provided by riverbanks, streambeds, landslips and edges of marshes, and the clearing of the forests has allowed them to extend their area. But most of the species involved in stocking the old-established grasslands are essentially plants of extensive open habitats and dry soils, whose seeds are not adapted for dissemination by wind, and whose nearest known primary habitat is the lowland savanna and savanna-forest between the Fly and Digoel Rivers, 300 to 350 km. to the east and southeast. Bridging this considerable gap, at least man-made habitats suitable for such plants may be expected to occur at intervals, if not on the sparsely peopled lowlands, almost certainly in inhabited valleys on both sides of the central range; but so far as is known to the writer, the farthest inland savanna on the Fly is 200 km. from any grassy mountain valley. Plants of the savanna grasslands apparently occupy, from end to end of the island, isolated mountain stations such as the Balim Valley,

besides many lower altitude stations such as Lake Sentani. But with the exception of the *Eucalyptus-Melaleuca* savannas of the semi-arid Fly-Digoel area and the area between Cape Possession and the Kemp Welch River on the south side of the island, and perhaps an area about Cape Vogel and another on the Rai Coast on the north side of the island, all the known New Guinea grasslands at low to moderate elevations are a secondary condition due to the activities of man.

Six true grassland birds were found in the Balim Valley by Rand, who furnishes the following significant data on their known distribution. Two, *Lonchura teerinki* and *Malurus alboscapulatus balim*, proved new species and subspecies endemic in the valley. The latter has its closest relatives in south New Guinea, and a very different race occurs at Lake Sentani. Of the remaining four, one, a quail, occurs in south and east New Guinea, but has not been found in any northern locality west of the Watut River; two belong to south and southeastern races of species represented by different races on the north side of the island; the other is a widespread bird whose exact status has not been determined.

Zoological and botanical exploration in New Guinea is not, however, sufficiently advanced for much importance to be attached to instances of apparent local endemism. But for small collections from the Mt. Hagen area and the Markham River headwaters in Northeast New Guinea, scarcely anything is known of the fauna and flora of the numerous deforested valleys of the central mountains for the stretch of 900 km. between the sections examined by the Archbold expeditions of 1933–34 and 1938–39. The new birds of the Balim discovered by the last-named expedition may be no more endemic in that valley than the extra-limital grasses *Andropogon intermedius* R. Br. and *Aristida Cumingiana* Trin., whose only recorded station for the island is the Balim Valley. Yet apart from the occurrence of birds whose endemism, if granted, can not be held to argue the existence of their habitat before the advent of agricultural man, no evidence is available upon which an estimate as to the age of grasslands such as those of the Balim might be based, unless the controversial question of the introduction of the sweet-potato is taken into account.

In the Balim Valley, as in the valleys of the Purari Plateau in Northeast New Guinea, where great native populations live at elevations of approximately 1500–2000 m., the sweet-potato, now accepted as of Central or South American origin, is the basic crop. Taro, the staple in some of the less elevated New Guinea valleys, is grown as a very minor subsidiary crop, as are bananas, sugarcane and cucumbers. Yams, which were not seen in the Balim Valley, appear not to succeed at

altitudes above about 1500 m. Frederici[1] explains the important position attained by the sweet-potato as a food crop on the islands of New Zealand, Rapanui and Hawaii as due to climate, which is particularly suited to the sweet-potato on those islands, but not so favourable to the tropical crops that provide the basic food in other parts of Polynesia. The importance of the sweet-potato in the high valleys of New Guinea might also be explained by climate. Whether an original crop brought in by the settlers of the valleys with food plants of old world origin such as taro, bananas, sugarcane and perhaps yams, or a replacement crop that appeared later, its present pre-eminence, based on its advantages in point of yield, is such that it is doubtful if the populations could have reached their present development on any other available food source. Grounds therefore exist for the view that most of the activity in converting the high valleys to grass post-dated the arrival of the sweet-potato. If, as held by Dixon[2] and others, this crop was introduced into Polynesia through pre-Caucasian contacts with the American continent, it might conceivably have reached New Guinea, by way of Melanesia, at a very early date. If Frederici is correct in considering it a Spanish introduction in Polynesia, and in attributing to the Spanish and Portuguese its introduction everywhere west of the Solomon Islands, the sweet-potato is unlikely to have appeared on the New Guinea coast before the middle of the sixteenth century.

Pure secondary forests of *Casuarina 11172,* 25–30 m. high, conserved in blocks and strips on riverbanks and the lower slopes, were a striking feature of the landscape in the vicinity of the Balim Camp. This wind-dispersed tree and *Ficus 11167,* a low tree also abundant on river flats, formed, on the debris of the great erosion cut mentioned on page 280, the largest stand of second growth forest in the locality. The generally sandy soils of old grass slopes carried in places sparse brushes of **Vaccinium adenanthum* Sleumer, *Alphitonia ferruginea* Merr. & Perry, *Grevillea subargentea* C. T. White, *Timonius 11748, Decaspermum 11643, Glochidion 11642* and *Piper 11670,* 3–5 m. high. In sclerophyllous scrubs on limestone knolls and declivities, *Grevillea, Rhamnus javanicus* Miq., *Leucosyke 11632,* **Eurya Dielsiana* Kobuski and *Schefflera 11713* figured as low trees and shrubs. **Ilex Versteeghii* Merr. & Perry, *Maesa? 11769* and especially *Xanthomyrtus 11784* formed low shrubberies on stony slopes above 1700 m.

A distinctive scrub community, dominated by **Vaccinium adenanthum* Sleumer, occupied a patch of poor loose sand at an elevation of

[1]Frederici, G. Ges. Volkerk. 7: 2–7. 1936.

[2]Dixon, R. B. Amer. Anthropologist 34: 40–66. 1932.

2100 m. Only 3–4 m. high, this resembled the scrubs of the 2150 m. Camp in the abundance of *Mearnsia cordata* White & Francis and *Kania 11764,* and of the ericoid subalpine shrub *Rhododendron 11751* fringing the edges. Conspicuous about the borders, and in glades of bracken (*Pteridium lanigerum* (Bl.) Copel.), were *Rhododendron 11758,* with fragrant white flowers, and large clumps of *Gahnia 11765.* Similar secondary scrubs occurred at an elevation of 2200 m. at the mouth of the Bele Valley.

Bele River (2200 m.) Camp, 18 km. northeast of Lake Habbema

This camp was occupied by the collecting party from November 9 to December 5. It stood on a grass patch on the high right-hand bank of the river, here a rapid mountain stream with a rocky and bouldery bed 20 m. wide. Just below camp the river entered a limestone gorge. Upstream were several narrow stretches of alluvial bank edged with gravel, and at a distance of half a kilometre, a shorter gorge. Clear mornings, crisp in the early hours, and rainy afternoons characterized local weather conditions. Four days were without rain, 5 overcast throughout, and 16 rainy in the afternoon — the heavier rains often accompanied by thunder and continuing to 8 or 9 p.m. There was little air movement in this narrow valley, which lay directly across the path of the tradewinds and was protected on either side by high mountain spurs. Cloud formation on the slopes lacked the regularity exhibited in localities exposed to steady air currents, and although clouds drifted in from the Balim Valley, the general movement was downward from the higher mountains. Generally, however, mist clouds clung to the slopes after about 10 a.m., their lower limit in fairly close correlation with the upper limit of cultivation at approximately 2400 m. Temperature: maximum (22 days) 19–26, mean 23, minimum (22 days) 9–12.5, mean 10.5 degrees Centigrade. Relative humidity (isolated readings): at 6 a.m. 88%–95%, mean for 8 days 91%, at noon 43%–66%, mean for 5 days 55%.

From the bottom of this valley, or the upper edge of the native gardens, magnificent forests of *Nothofagus* extended up the slopes of the range to an altitude of 3100 m. near Lake Habbema. In the Bele Valley these forests consisted of three species of towering clear-boled trees that attained a height of 40 m. or more and a diameter of well over 1 m. Distinguishable at a distance by the pale reddish colour of its young leaves, *N. 11369* supplied most of the stocking below 2400 m., *N. 11115,* with young leaves of a deeper red, rougher bark and larger

fruit, dominated the forest above that level, and *N. 11335*, yellowish in young leaf, was plentiful at about 2300 m. Lauraceae supplied 6, *Elaeocarpus* 7, *Syzygium* 8, Cunoniaceae 8, *Podocarpus* 2 (the only conifers) and Fagaceae 4 of a total of about 60 collected species of associated trees that attained a diameter of 25 cm. or more between elevations of 2200 to 2500 m.

The *Nothofagus*-forests of these altitudes on the slopes of the Snow Mountains differed vastly in character from those of the mountains southwest of Bernhard Camp. The term "mossy-forest," which has been used to describe several types of stunted mountain forest in Malaysia, could not be applied here. Above, and even below, the rather arbitrary level of 2400 m. set for the line of demarcation between the two *Nothofagus* consociations, there was, however, especially on the crests of spur ridges, a considerable development of mossy ground cover; hepatics and mosses formed soft mounds about the bases of the great trees, and the soil became generally too peaty for cultivation. The topmost gardens were in hollows between spurs, where mossed conditions were less pronounced, and rain-forest elements conspicuous in the forest. Further description of the *Nothofagus*-forests is deferred for the 2800 m. Camp, where they exhibited the same broad characteristics.

Many of the commoner rain-forest elements which, particularly as regards undergrowth species, lent a tropical aspect to parts of the forest on riverbanks and in moist hollows and extended in diminishing numbers far up the slopes in this locality, reached still higher altitudes in valley bottoms. The following characteristic rain-forest families, all but one represented by single species, appeared to reach the upper limit of their range in primary *Nothofagus*-forest between 2200 and 2500 m: Sapotaceae (*No. 11139*), Staphyleaceae (*Turpinia 11143*), Icacinaceae (*Platea 11119*), Meliaceae (**Aglaia Versteeghii* Merr. & Perry), Chloranthaceae (*Chloranthus 11479*), Celastraceae (**Perrottetia traumatophylla* Merr. & Perry), Oleaceae (**Linociera Brassii* Kobuski, *Jasminum domatiigerum* Lingelsh.), Begoniaceae (*Begonia 11228*). *Aristotelia 11526, Sloanea 11217, Excoecaria 11209, Peperomia 11227* and **Flindersia chrysantha* Merr. & Perry represented rain-forest genera not found at higher levels.

Additional proof of the value of the oaks and *Castanopsis* as indicators of superior arable land was provided by their distribution in this locality. At the lower levels they, and their associate *Engelhardtia 11061*, were common throughout the forest as subsidiary trees of 25–30 m., and they survived as relics on cleared land. In a few places, between 2200 and 2350 m., these trees formed limited pure stands on the broad crests

of spurs, but none was encountered much above the upper limit of cultivation. Distinguished by their open character under the canopy, the dry appearance given by the slippery ground litter of cutinous dead leaves, and the virtual absence of ground moss between the trees, the oak-forests held few ferns, orchids or other herbaceous plants. *Rhododendron 11057,* with yellow flowers, was a common shrub, *Dimorphanthera 11296, Alyxia 11300* and *Aeschynanthus 11458* common among scrambling shrubs and climbers, *Drimys 11295, D. 11294, Ilex spicata* Bl.(?) and *Kania 11292* characteristic small trees of the high undergrowth and substage. The oaks concerned were *Lithocarpus 11353, L. 11396* and *L. 11477. Castanopsis 11512* showed preference for the lower slopes.

Gradually the forests were being eaten into as the people of several village groups extended their communal clearings. Most of the producing gardens were on new land strewn with the trunks of large beech trees brought down by being burnt through at the base. Other trees, killed by fire or by ring-barking, stood as they had grown in the forest. The older parts of the cleared areas were occupied by *Imperata* grasslands and two distinct ecological types of seral or secondary forest.

New clearings in the lower forest zone were burnt over when the smaller timbers were dry enough to carry a good fire and the blackened ground immediately put under crop. Different methods were employed in the peaty upper forest zone, which to a small extent was being brought under cultivation. There, after the undergrowth was cleared and the trees felled, a period of some years of drying out and oxygenation by exposure to sun and wind seemed necessary to fit the soil for cultivation. On such seasoning plots there developed, as in openings in the mossy beech-forest at the 1800 m. Camp, a community of small trees and shrubs largely dominated by a species of *Rapanea* (*No. 11288*) from the undergrowth of neighbouring primary forest, and containing also *Kania 11292, *Ilex Versteeghii* Merr. & Perry, *Eurya Tigang* Schum. & Lauterb., red *Rhododendron 11293,* yellow *R. 11057,* scrambling *Dimorphanthera 11296, Alyxia 11577* and the scrambling bamboo *No. 11072.*

Seral growths of familiar lowland rain-forest type found suitable conditions for development on formerly cultivated soils of the lower forest zone. This complex vegetation exhibited many faces and phases in what would appear two main lines of development, one from *Imperata* grassland, the other a direct successional movement on abandoned gardens cleared from primary or secondary forest. On rocky grass slopes near the river, flat-topped *Maoutia? 11075* and *Pipturus 11390,* sclerophyllous *Ficus* spp., scrambling *Rubus rosaefolius* Sm., *R. Ledermannii* Focke

(?) and **Sticherus habbemensis* Copel. were followed by hardy representatives of the *Macaranga* complex. Higher on the slopes, on deep soils apparently long under grass, slender little *Buddleia 11521* formed distinctive savanna-like stands in which *Dodonaea viscosa* (L.) Jacq. was chiefly responsible for setting up forest conditions. Succession on recently cleared forest land usually began with the replacement of garden weeds by dense 2 m. high growths of *Saccharum spontaneum* L. or **Cyathea pilulifera* Copel., or both. Characteristic species of the young forests that followed were *Macaranga 11398, M. 11212, Saurauia 11208, Homalanthus 11561, Dodonaea viscosa* (L.) Jacq., *Ficus 11418, Glochidion 11074, Piper 11054, *Kibara laurifolia* A. C. Smith, *Schefflera 11201* (forming a vaulted under layer on some rocky slopes), and scrambling or climbing *Rubus* spp., *Muehlenbeckia 11205, Polygonum 11504* (at Lake Habbema and intermediate levels), *Clematis 11235, Lycopodium 11204, *Sticherus habbemensis* Copel. and *Isachne albens* Trin.

Next in importance to *Imperata cylindrica* (L.) Beauv. in a meagre grassland flora of about 20 species were *Pollinia leptostachys* Pilg. and *Setaria geniculata* (Lam.) Beauv., which attained dominance on some dry slopes, and *Ischaemum digitatum* Brongn., which claimed the moister ground. Minor species included *Sporobolus elongatus* R. Br., *Isachne globosa* (Thunb.) Ktze., *I. micrantha* Merr., *Oxalis corniculata* L., *Calamintha 11468, Cynoglossum javanicum* Thunb. and climbing *Melothria 11082*. Characteristic of wet spots were *Juncus effusus* L., *Viola 11371,* and beds of *Leersia hexandra* Sw.

It was somewhat of a surprise to find in the gardens a species of *Bidens* (*No. 11557*) which, with the scarcely less aggressive *Polygonum 11558,* confronted the native cultivators with a serious problem in weed control. Scrambling over garden fences and soon taking possession of neglected village enclosures were *Oenanthe javanica* (Bl.) DC. and *Stellaria 11582*. Also plentiful as weeds about villages were *Rumex 11387* and *Desmodium Scalpe* DC. Although not seen growing, *Solanum nigrum* L. was vended by the natives as a green vegetable, as were the young shoots of *Oenanthe*.

Riverbanks, and for that matter all kinds of open habitats in the forested mountains, provide special microclimates in which both lowland and highland plants are enabled greatly to extend their normal altitudinal range. This is discussed at length by van Steenis[1] in his exhaustive study of the origin of the Malaysian mountain flora. The occurrence of subalpine *Libocedrus* and species of *Rhododendron* and *Vaccinium*

[1]Bull. Jard. Bot. Btzg. III. 13: 289–417. 1935.

in open dry habitats, far below their normal levels, is mentioned earlier in this paper. The lowest station observed for alpine grassland plants was at 2200 m. on the Bele River, where *Poa longiramea* Hitchc., *Brachypodium pubifolium* Hitchc., *Ranunculus 11422* (also on forest paths) and *Hydrocotyle 11307* grew on mossy rocks in the stream. These examples of abnormal vertical distribution are in accordance with general tendencies observed on the slopes of the Snow Mountains, namely, for plants of the alpine grasslands to reach their lowest, and lowland plants of the forests their upper limits, in open moist habitats, and, on the other hand, for lowland plants of the open grasslands to occur at their highest, and highland plants of the forest and scrub communities their lowest levels, in open dry habitats.

2800 M. CAMP, 9 KM. NORTHEAST OF LAKE HABBEMA

Collections were made here between October 8 and November 8, an off season for flowering at this altitude, and a time when few birds and mammals were breeding. The camp was in the bottom of the rather steep-falling little valley of one of the headwater streams of the Bele River. Sharp spur ridges, considerably lower than those that hemmed in the river basin, rose 50 to 100 m. from the bed of the stream on both sides. The country was entirely forested except for landslips along the streams, a few small clearings planted with *Pandanus* and containing native huts, and occasional wet shrubby openings which had probably been enlarged by the natives who used them for resting places when hunting and travelling in the mountains. Although well up in the cloud belt, weather conditions were variable, and mists not very frequent or regular in occurrence in the immediate neighbourhood. The tradewinds appeared to carry less moisture than at lower altitudes, and when they were in operation the clouds tended to mass on the high spurs, so that valley conditions prevailed in the river basin. Dull, overcast and showery weather was nevertheless the rule. For eight days beginning with November 1 the wind came from the northwest in a general disturbance which brought daily rain far heavier than was usual at other times. Two entirely clear days, and ten on which hours of sunshine ranged from approximately four to nine after 6 a.m., were experienced in the month. No less than nine days were without rain. Temperature: maximum (18 days) 13.5–21.5, mean 17.5, minimum (19 days) 4.5–10.0, mean 7 degrees Centigrade. Relative humidity: 6 a.m. (14 readings) 87%–94%, mean 93%, 1–2 p.m. in clear weather (5 readings) 44%–63%, mean 54% of saturation.

In this area of small spurs and valleys little better than ravines, the

separation of the *Nothofagus*-forests into a lower zone dominated by *N. 11103* and an upper zone of *N. 10243* was not well marked. The former was in control at 2700 m. on some spurs, the latter apparently almost sole dominant from 2800 m. up to 3100 m. The forest had many faces. In the usual splendid development, that clothed ridges and valleys alike, the dominants grew to 35–40 m. high and up to 1–1.5 m. in diameter above their spurred base, the tallest forest being found on the slopes. On occasional flat seepage-wet benches in the valleys, the rather stunted forests carried a thick layer of green bryophytes on the ground and lower tree-trunks and held few of the usual ferns and orchids. On narrow ridges, especially above 2850 m., the stand degenerated into a typical open "mossy-forest" 15 m. or less in height, with a deep ground cover of brownish hepatics and matted surface roots, the trees themselves blanketed and cushioned with mosses and hepatics and hung with pendent ferns and orchids to 5–8 m. of their length. In general, ground, trees and undergrowth were abundantly mossed down to 2600 m. or lower on the summits of spurs, and about 2700 m. in the valley bottoms. Collections were made between altitudes of 2600 and 3200 m., where numerous plants reached the upper or lower limits of their range. Most rain-forest species were restricted to moist bottoms or the lower slopes of ridges and few extended above the 2750 m. level. Of a total of approximately 50 trees of which at least some individuals attained a diameter of 25 cm. in primary or secondary forest, Coniferae furnished 4, Lauraceae 2, Cunoniaceae 5, *Elaeocarpus* 5, *Pygeum* 2 or 3, *Evodia* 2, *Melicope* 2, *Saurauia* 2 and *Pittosporum* 2 species.

The small amount of moss on the lower slopes, with the wet-tropical character of the vegetation on small flats along the stream up to 2750 m. in the camp valley, gave the forests there an appearance of rain-forest. The subsidiary trees *Garcinia Schraderi* Lauterb., *Ascarina 10475, Glochidion 10495, Laportea 10485* and *Syzygium 10498* represented rain-forest genera there at the upper limit of their altitudinal range. A very luxuriant undergrowth on moist flats, characterized by *Pilea 10769,* also contained *Alocasia 10973* (to 2800 m.), subscandent *Piper 10299* and *Cyrtandra 10596, *Marattia coronata* Copel. with great fleshy fronds (2300–2800 m.), and the treeferns **Cyathea bidentata* Copel. and **Dicksonia Archboldii* Copel. Especially tropical in floristics and physiognomy were the seral growths in house clearings and other openings, where big-leaved *Macaranga 10969* (to 2900 m.), *Saurauia* spp., *Homalanthus 10297* (1 sp. at 3300 m.) and **Melicope mucronata* Merr. & Perry occurred as trees of 8–20 m., *Cypholophus 10586, Psychotria 10989* and *Solanum 10764* as small trees and shrubs, and *Tetrastigma Pullei* Lauterb. (to 2800 m.) and *Strongylodon 10755* as climbers.

From about 2800 m. to 3100 m. the principal large subsidiary or subcanopy trees were *Phyllocladus 10528* (down to 2600 m.), a glaucous form (?) of *Podocarpus papuanus* Ridl. (*No. 10513*), long-leaved *P. 10452, Fagraea 10541* and *Elaeocarpus* spp. Components of a conspicuous substage tree layer included *Xanthomyrtus 10521* (particularly in low "mossy-forest"), *X. 10584, Rapanea 10258, Vaccinium minuticalcaratum* J. J. Sm., *Litsea 10708, Elaeocarpus 10576* (along streams), *Schefflera 10805* (also epiphytic), *Cephaloschefflera 10997* and *Symplocos 10707*. Small-leaved *Xanthomyrtus 11001, Rapanea 10849* and **Vaccinium debilescens* Sleumer, together with **V. otophyllum* Sleumer, *Rhododendron 10250, Styphelia nubicola* Wernh. and *Pygeum rigidum* Koehne (down to 2150 m.), formed a plentiful woody undergrowth in the open mossy forest of crests; *Pygeum, Amaracarpus? 10522* and the tree-ferns **Cyathea everta* Copel. and **C. bidentata* Copel. were perhaps most characteristic of heavily shaded slopes; and restricted to valley bottoms was a set of small trees with larger leaves, such as *Symplocos 10501, *Eurya habbemensis* Kobuski, *Drimys 10570* and Araliaceae *10784*. The only woody climbers in primary forest were **Ilex scabridula* Merr. & Perry, *Dimorphanthera* spp. (2) and **Freycinetia sterrophylla* Merr. & Perry. As woody epiphytes **Vaccinium oreomyrtus* Sleumer, several attractive *Rhododendron* spp. and *Myrmecodia 10689* (in treetops) were common, while *Henslowia* spp. (2) and *Loranthus* spp. (3) occurred as parasites.

Everywhere rather poor in species, the herbaceous undergrowth of exposed crests consisted chiefly of tangled orchids, rooting in the moss; the ferns **Plagiogyria tuberculata* Copel., *Grammitis frigida* (Ridl.) Copel., **G. hispida* Copel. with variegated leaves, *Polypodium Werneri* Ros. and *Meringium rubellum* (Ros.) Copel. were common throughout on mossy ground; *Dryopteris Engleriana* Brause var. *hirta* C. Chr., *D. Wollastonii* (v. A. v. R.) C. Chr. (?), **Pteris macrophylla* Copel. and *Asplenium Foersteri* Ros. occurred with *Elatostema* spp. and a scattering of small Zingiberaceae in the valley bottoms. *Polypodium Werneri* Ros., *P. albidosquamatum* Bl., *Selliguea crassisora* (C. Chr.) Copel., *Calymmodon clavifer* (Hook.) Copel., *C. cucullatus* (Nees. & Bl.) Presl, *Ctenopteris taxodioides* (Baker) Copel., *C. millefolia* (Bl.) Copel., **Prosaptia Archboldii* Copel., **Grammitis habbemensis* Copel., **Xiphopteris antipodalis* Copel., *Mecodium bismarckianum* (Christ) Copel., *M. novoguineense* (Ros.) Copel., *Meringium gorgoneum* Copel., **M. Brassii* Copel., *M. rubellum* (Ros.) Copel., *Loxogramme subselliguea* (Baker) Alston, ***Lepidocaulon caudatum* Copel., *Humata kinabaluensis* Copel., and less commonly *Asplenium* spp., *Hymenolepis* spp. (including *H. validinervis*

Kunze, restricted to the leafy crowns of *Pandanus*) and *Elaphoglossum* spp., among ferns, and *Ceratostylis, Glomera, Mediocalcar, Phraetia* and *Dendrobium* species, among orchids, comprised the bulk of a very rich flora of moss-inhabiting epiphytes.

Frequent small openings in the tall valley forest from about camp level up to 2900 m., resulting from the fall of big trees affected by "dry rot," were claimed by communities which, owing to their mixed derivation, in the older stages were not always readily distinguished as secondary. Associated with invaders from the primary forest substage and high undergrowth were seral trees such as *Pittosporum ramiflorum* Zoll., *Acronychia murina* Ridl. (?), **Vaccinium obovalifolium* Sleumer (also at Lake Habbema), **Ilex Versteeghii* Merr. & Perry, *Evodia trichopetala* Lauterb., *Olearia 10651* and *Timonius 10642*. Prominent in young growths were *Drimys 10246, Rhododendron 10250* with big pink flowers, *R. 10563* with red or yellow flowers, the scrambling shrubs *Coprosma 10587*, **Palmeria habbemensis* A. C. Smith and *Rubus Lorentzianus* Pulle, rambling *Polygonum 10759, Equisetum 10756* and *Histiopteris incisa* (Thunb.) J. Sm., clumps of **Dryopteris spinosa* Copel. and showy *Languas* spp.

The seral communities of landslips along streams contained some peculiar floristic elements and a matter of 150 to 200 m. difference in altitude brought about striking changes in their constitution. The open parts of a large slip of crumbling marly limestone at 2780 m. altitude carried a short growth of *Schoenus? 10923, Imperata cylindrica* (L.) Beauv., *Viola 10839* and the prostrate shrub Myrtaceae *10921*, with which were associated alpine *Tetramolopium 10914* and *Anaphalis 10699*. Around the edges *Gahnia 10749* mingled with scrambling **Sticherus habbemensis* Copel., *Lycopodium cernuum* L. var. and *Equisetum* in low woody growths of *Rhododendron, Homalanthus, Coprosma, Rapanea 10932* and especially *Myrica 10938*, which passed into a stand of *Xanthomyrtus* spp. and young *Nothofagus*. At 2600 m., where the camp valley narrowed into a ravine with very unstable slopes that showed exposures of a hard grey limestone, alpine plants, *Myrica* and *Coprosma* were absent, and *Pollinia leptostachys* Pilg., *Spathoglottis 10866, Dipteris novo-guineensis* Post., *Buddleia 11521, Astilbe 10864* and the slender shrub **Hypericum habbemense* A. C. Smith reached the upper limit of their range on dry sunny parts of the landslips.

On stony beaches in the stream between 2700 and 2800 m. were found *Ranunculus 10546, Sagina? 10552, Epilobium 10551* (also colonizing loose clay banks with the moss **Philonotis hamata* Bartr.), *Carex* spp. and **Trigonotis abata* Johnst. of the alpine grassland flora.

Other highland grassland plants such as **Potentilla novoguineensis* Merr. & Perry, *Luzula 10737* and *Agrostis retrofracta* Willd. grew in a native house clearing at 2800 m., which was also the topmost station observed for a number of open ground plants of low altitudes, including *Setaria geniculata* (Lam.) Beauv., *Sacciolepis contracta* (Wight & Arn.) Hitchc., and the weeds of cultivation *Bidens 11557, Glossogyne latifolia* DC. and *Arthraxon hispidus* (Thunb.) Merr.

The only palms found on the slopes of the Snow Mountains were two species of *Calamus*, one common at 2200–2300 m., the other extending as high as 2650 m. There were but three species of Pandanaceae, **Freycinetia linearis* Merr. & Perry extending to 2600 m. and **F. sterrophylla* Merr. & Perry to 2850 m. in moist valley bottoms, and one large species of *Pandanus* (perhaps **P. brosimos* Merr. & Perry) which appeared to occur naturally in beech-forest up to 3000 m. and was cultivated for its seeds. A single example of another *Pandanus*, a striking clumped species with broad leaves and large ovate-cylindrical fruitheads, was seen in a garden in the Balim Valley, but could not be collected.

The following families reached the upper limit of their range in the 2800 m. camp locality: Cunoniaceae (*Quintinia 11007*, 3300 m.), Aquifoliaceae (**Ilex Versteeghii* Merr. & Perry, 2950 m.), Loganiaceae (*Fagraea 10453*, about 3000 m.), Euphorbiaceae (*Homalanthus* sp., to 3300 m.), Melastomataceae (*Memecylon 10500*, 2800 m.), Moraceae (*Ficus 10783*, 2700 m.), Gesneriaceae (*Cyrtandra* spp., to 2800 m.), Leguminosae (*Strongylodon 10755*, 2750 m.), Solanaceae (*Solanum 10764*, 2700 m.), Cucurbitaceae (*Melothria 10621*, 2800 m.), Sapindaceae (*Dodonaea viscosa* (L.) Jacq., 2650 m.); of genera not previously mentioned as at their upper limit, *Gunnera, Clematis, Adiantum, Lindsaya, Vittaria* and *Antrophyum* all dropped out between the 2700 m. and 2800 m. levels.

Lake Habbema

At this camp, the first general collecting station of the expedition established inland, botanical collections were made between July 22 and September 4. Boiling point observations gave an altitude of 3225 m. for the lake surface. The upper end and much of the south shore of the lake were bordered by open marsh. Several timbered ridges touched on the north shore, where a deep bay provided a sheltered anchorage for the flying-boat and a good site for the camp. The season was most opportune for collecting. All but one of the flowering plants bore flowers or fruits or both, and all ferns and most bryophytes were in fertile condition.

The flight from Hollandia to the lake was made in about 90 minutes. At the beginning, most of the party were affected by the rarity of the air and the physiological upset occasioned by the sudden change in altitude. Breathing was difficult, and feet seemed weighted to the ground. In a few days, however, all but a very few had accommodated themselves to the new conditions. Despite warm clothing, good food and housing and an abundant supply of firewood, there was not much margin of comfort when, as it frequently did, the temperature fell below freezing point, and even the hardiest individuals felt the cold when afield in the chilling drizzle that accompanied the normal afternoon mist. On clear days, when the sun shone intensely bright and the rapid evaporation of high altitudes so dried the less sappy plants of the open ground that they crunched and broke underfoot, standard shade temperature rose as high as 21° Centigrade, while relative humidity fell as low as 33 per cent. Native personnel as well as Europeans were troubled with sunburn and cracked lips in the week of almost rainless weather that closed the month of July. A grass temperature of 36° was recorded on a sunny day on which maximum shade temperature reached only 18 degrees.

August was a month of inconstant weather in which rain fell on eighteen days, hail on three occasions, and there were two thunderstorms. Most of the rain fell during the afternoon and night. Only two days were wet throughout. Heavy fogs over the lake and its surroundings, of which there were twelve in August, lasting from before dawn to about 7:30 A.M., were followed almost invariably by bright sunshine until at least early afternoon. On such days the fog would be cleared by a slight southeast breeze, followed by a fitful east air, then a gusty northeast breeze that brought up dark driving clouds, mist and rain. A six day spell of bleak unsettled weather, with intermittent rain, came, however, from the southeast. No violent winds were experienced.

The frequent rains of August were sufficient to compensate evaporation and keep the peaty soil in a constant moist to wet condition, but there was little surface run-off. Receipts from drainage and precipitation on its surface failed to balance discharge and evaporation from the lake, the waters of which fell 20 cm. during this period, exposing beaches of sand and oozy mud, but were brought back to their former level by heavy rains during the afternoon and night of August 31.

Rainfall records were kept by the military party for the three months August to October. The records for August are not available. During September, measurable precipitations on 21 days gave a total of 284 mm. In October, falls of 4 to 25 mm. on 21 days totalled 258 mm.

Temperatures for the period July 26 to September 3 were: maximum

(37 days) 11–21, mean 18, minimum (38 days) minus 3 – plus 4.5, mean 1.1 degrees Centigrade. There were 14 minimum readings of zero Centigrade or lower. Diurnal variation ranged from 10 to 22.5 degrees, as compared with 6.5 to 14 degrees for the 2800 m. Camp. Readings of relative humidity were made for the purpose of ascertaining extreme rather than average conditions. It was found to range from 92% to 100% at 6.30 a.m., and from 76% to 82% at 6 p.m. (sundown). In dry sunny weather, readings of 33% to 59% were obtained at noon, and 46% to 58% at 1 p.m.

Sandstones alternated with limestones from the Grand Valley of the Balim River to the highest parts of the Snow Mountains. For the most part the rock of the Lake Habbema area was a pale greyish sandstone. Large boulders of sandstone lay strewn on the lower slopes of some of the ridges, it showed frequently in little hillocks, and there were massive exposures on the parallel ridge on the south side of the lake. That limestone was also present was indicated by rather numerous sinkholes on the ridges. Irrespective of plant cover and rock formation, the mineral soils of the whole area were covered by peats.

Closed forest in this locality was strictly confined to the ridges. It developed in patches, sometimes very small, occasionally up to one or even two hundred metres in length and breadth. These patches usually occurred in association with limestone. Not all limestone sinkholes were in closed forest, but in nearly every patch of closed forest, however small, could be found at least one sinkhole. In at least some of the forest patches the surface layer of peaty material rested on yellow clay. There were two distinct tree strata, the upper approximately twice the height of the lower. The upper tree layer consisted of a generally open stand of *Libocedrus 9241, Phyllocladus 9058,* and especially *Podocarpus papuanus* Ridl., usually 12–15 m. high and up to 50 cm. in diameter, in which occurred *Podocarpus 9341* and, appearing much out of place in its surroundings, *Schefflera 9091* with glossy rayed leaves and large red inflorescences terminating its branches. Dominating the forest and constituting most of the lower tree layer was **Vaccinium dominans* Sleumer, which with *V. minuticalcaratum* J. J. Sm., **V. obovalifolium* Sleumer, *Rapanea 9550, R. 9080, Symplocos 9340,* **Pygeum retusum* Merr. & Perry, *Elaeocarpus 9092, Litsea 9559, Xanthomyrtus 9018* and *Timonius 9504* as minor dominants, and *Xanthomyrtus 9018, Olearia 9146, O. 9143* and *Saurauia 9140* occurring chiefly about the edges, formed a dense low canopy under the conifers. Often the trees of the lower layer branched at ground level and should perhaps be called shrubs. Most of them had crooked or leaning, finally

upright stems and branches, erect branchlets, and crowded thick leaves entirely smooth or pubescent on the under side. Under closed canopy conditions, the forest interior presented a dim monotony of shaggy treetrunks but slightly relieved by a few small epiphytic ferns and still fewer ground ferns and shrubs. Thinner than in the stunted *Nothofagus*-forest of lower levels, owing to the dense canopy, here, too, the bryophyte cover on ground and trees consisted mainly of hepatics. The shade-loving treeferns *Dicksonia Hieronymi* Brause and **Cyathea costalisora* Copel. appeared in a sparse tall undergrowth in which *Drimys 9362, Pittosporum ramiflorum* Zoll., **Vaccinium debilescens* Sleumer, *Acronychia murina* Ridl. (?), *Cephalosche fflera 9377* and red-flowering *Rhododendron 9141* showed preference for better lighted conditions. Good lighting permitted the development of a plentiful herbaceous undergrowth of Urticaceae *9292* and *Pilea 9293,* 50 cm. high, while under heavy shade the ferns *Meringium rubellum* (Ros.) Copel., *Selliguea Feei* Bory, *Ctenopteris allocata* (v. A. v. R.) Copel., *Grammitis integra* (Brause) Copel., *Dryopteris hypolepioides* Ros., **D. habbemensis* Copel. and *Athryium japonicum* (Thunb.) Copel. grew from the ground moss. The only climbers were *Dimorphanthera 9363* with large palatable fruit, *Rubus Lorentzianus* Pulle and *Piper 9134,* which scrambled about the borders and appeared under breaks in the canopy. Pendent tuft ferns such as *Ctenopteris pendens* (Ros.) Copel., **C. bipinnata* Copel., **C. Brassii* Copel., *C. whartoniana* (C. Chr.) Copel. and *Calymmodon cucullatus* (Nees & Bl.) Presl, the Hymenophyllaceae *Meringium rubellum* (Ros.) Copel., *M. Brassii* (C. Chr.) Copel., *Microtrichomanes digitatum* (Sw.) Copel. and *Mecodium imbricatum* (Bl.) Copel., *Grammitis subrepanda* (Brause) Copel., *G. integra* (Brause) Copel., *G. knutsfordiana* (Baker) Copel., *Selliguea Feei* Bory, *Asplenium hapalophyllum* Ros., *A. setisectum* Bl. and *Polystichum alpinum* Ros., a few orchid species, and the shrubs **Vaccinium debilescens* Sleumer, *Rhododendron 9486* and *Hydnophytum 9506* supplied the epiphytic flora. *Loranthus 9361* was a common parasite under the canopy.

Shutting out from the forest the strong light and drying wind of the grasslands, and forming a living firebreak, was a compact wall of upright shrubs 1.5–2 m. high, which had to be forced apart or cut through to gain the forest interior. Associated with ericoid *Styphelia Vandewateri* Wernh. and *Rhododendron 9024,* which formed the bulk of the border shrubberies, were other *Rhododendron* spp., *Drimys 9068,* straggling *Coprosma 9028* and *C. 9144,* rooting in deep beds of **Macromitrium altipapillosum* Bartr. and other mosses. Prominent in this very narrow ecotone were the quaint xerophytic treeferns **Cyathea*

tomentosissima Copel. and occasionally **C. cheilanthoides* Copel., and on its grassy outer edge grew the herbs *Stellaria 9122, Acaena anserinifolia* (Forst.) Domin, *Myosotis saruwagedica* Schltr., *Libertia 9216* and silver-grey *Potentilla papuana* Focke. Sometimes, on borders disturbed by fire, gradated shrubberies of *Coprosma, Rubus paradoxus* Ridl., *R. Ferdinandi-Muelleri* Focke, *Hypericum Macgregorii* F. v. Muell., etc., extended out on to the grassland.

Closed forest, as described, occupied but a small part of the wooded ridges in the Lake Habbema area. The prevailing tree communities of the sandstone ridges, which approached the open grasslands of the valleys and hollows in extent, were at best an open forest of smut-darkened *Libocedrus* and *Podocarpus papuanus*, and on basal slopes often no more than a low savanna stand of *Libocedrus* alone. Fastigiate and symmetrical when young, the *Libocedrus* trees assumed distorted shapes in age, when their bizarre appearance was heightened by gouty *Myrmecodia* spp., which occurred everywhere as epiphytes on the conifers and also grew on the ground. Golden-brown and purplish bryophytes on the trees, and brilliant little *Dendrobium* spp. with orange, red, green or purple flowers, provided patches of colour. The ground vegetation which controlled the habitat in these forest successional or subclimax communities ranged from dwarf bog grasses and herbs to long tussock grasses, ericoid shrubberies and scrubs of broad-leaved trees stunted to the stature of shrubs. Pits dug in the shrubberies went through 20 to 50 cm. of peat before encountering a bleached subsoil of grey sand containing fragments of the parent sandstone.

Like the closed forests developed about limestone sinkholes, the scrubby low-tree thickets were much interrupted and fragmented by glades. Generally 2–3 m. high, very dense and rigid, heavily overgrown with hepatics and lichens, and half buried in the orange-brown ground mosses **Macromitrium altipapillosum* Bartr. and *Schlotheimia pilicalyx* Broth. & Geh., their chief components were *Xanthomyrtus 9018*, **Vaccinium dominans* Sleumer (major dominant of closed forest), **V. oreites* Sleumer, *Phyllocladus 9058*, **Pygeum retusum* Merr. & Perry and *Rapanea 9080*. *Schefflera 9091* was conspicuous as a tree of 4–6 m. Abundant as climbers were *Tecomanthe? 9052*, with great pink flowers, and *Alyxia 9114*. Characteristic of the edges were *Pittosporum pullifolium* Burk., *Drimys 9068* and *Rhododendron* spp. as tall shrubs, subprostrate **Vaccinium chionostomum* Sleumer and *Symplocos 9019*, *Trachymene 9064*, and masses of *Blechnum Hieronymi* Brause. Under favourable light conditions, small orchids and such ferns as **Polypodium crassimarginatum* Copel., *P. lamphrophyllum* C. Chr., *Dryopteris oligo-*

lepia v. A. v. R., *Selliguea crassisora* (C. Chr.) Copel., *Hymenolepis revoluta* Bl., **Elaphoglossum fuscum* Copel., **Grammitis graminifolia* Copel. and *Meringium rubellum* (Ros.) Copel. abounded in the ground moss. There was a remarkable wealth of epiphytic ferns such as *Selliguea Feei* Bory, *Grammitis scabristipes* (Baker) Copel., *Polypodium subundulatum* Ros., *Ctenopteris whartoniana* (C. Chr.) Copel., *Meringium Brassii* (C. Chr.) Copel. and **Humata Brassii* Copel., and especially of orchids, which included numerous *Bulbophyllum* spp. and showy *Dendrobium* spp.

Best developed in glades between low-tree thickets, and seldom extending far beyond the territory of the conifers, the ericoid shrubberies as a rule consisted of nearly pure greyish stands of *Rhododendron 9130*, a major dominant of the shrubberies fringing closed forest, and a species found in open sandy habitats down to 2100 m. in the Balim Valley. Common associates included *Styphelia obtusifolia* J. J. Sm. var. *hypoleuca* J. J. Sm., *Rapanea 9080*, *Tetramolopium 9025* and *Rhododendron* spp. as shrubs 0.5 to over 1 m. high, *Myrmecodia* spp. and the large clump sedge *Gahnia 9047*. Dwarf *Oreobolus 9244*, found everywhere on open peaty ground, and creeping *Lycopodium* spp. provided a stiff soil cover. In some dry situations the heath-like shrubs were replaced by prostrate *Xanthomyrtus 9074*, *Symplocos 9019* and *Gaultheria 9051*, or *Cladonia* and other lichens carpeted the ground. On dry points of ridges jutting into grassland, the shrubberies sometimes ended in dense growths of erect **Gleichenia squamosissima* Copel. and *Kelleria papuana* Domke, 20–30 cm. high.

Treeless grasslands occupied, besides the broad valleys and the basal slopes of the ridges rising from them, all the lateral hollows and numerous glades in the forests. The widest tract — that of the Balim-Wamena valley — was 4 km. across. The most important factors influencing their distribution would appear to be temperature and cold air drainage from the heights. Edaphic conditions and vegetation cover, on the wooded ridges as well as in the valleys, must be regarded as expressions of the climate. If climatic conditions in the area were uniformly suitable for the development of forest, forests could be expected to cover all but the marshes and rocky barrens. There was no evidence of any great expansion of the grasslands as a result of forest fires.

There were two types of grassland, readily separable on gross appearances, but in all but a few situations especially superior or inferior as regards soil conditions, comprised of approximately the same species — one a community of tall grasses, the other of dwarf grasses and sedges. Not often did one find the tall grasses unaccompanied by dwarf species,

and vice versa. The long-grass community, dominated by tussock-forming *Deschampsia Klossii* Ridl., developed as a distinct ecological unit on well drained soil about the forest edges, on the often somewhat elevated sandy banks of the deeply entrenched little streams that wound through the valleys, and on areas patently deforested by fire. Among the few grasses associated with the metre high dominant were *Hierochloë redolens* R. Br., *H. angusta* Hitchc., *No. 9050, Festuca nubigena* Jungh. and *Brachypodium pubifolium* Hitchc.; clumped *Gahnia 9047* occurred commonly throughout. Characteristic herbs included *Stellaria 9122, Myosotis saruwagedica* Schltr., *Potentilla papuana* Focke, *Acaena anserinifolia* (Forst.) Domin, *Erechtites 9552* and (locally) *Keysseria 9209*. Along the streams were found the small herbs *Trigonotis papuana* (Hemsl.) Johnst., *Oreomyrrhis 9323, Galium 9321, Plantago 9457, Hydrocotyle 9320* and *Hypericum japonicum* Thunb., *Luzula 9175*, and several small sedges and grasses. Areas of quaking bog also supported more or less closed communities of tall *Deschampsia*, with *Astelia 9188* in grey mats and cushions, *Ranunculus 9589* and other herbs, *Marchantia* sp. and *Sphagnum* sp. covering the ground in the interstices between the grass clumps.

Nearly everywhere in the short-grass community tufts of *Deschampsia*, 25–50 cm. high, grew from the close mat of rigid dwarf grasses and sedges that covered the ground. This community was typically developed on somewhat boggy flats and slopes and on the dry soil of treeless low ridges in the valleys. It appeared to occupy chiefly stations unsuited for the development of the long-grass community, which it greatly exceeded in total area. Only two to five centimetres high, the dominant *Monostachya oreoboloides* (F. v. M.) Hitchc., *No. 9185, Aulacolepis 9554* and *Oreobolus 9244* formed a fairly continuous cover on a ground surface smooth or somewhat bumpy with little pot-holes in which water lay after rain. This "bog-turf" was rich in mostly rosette-forming small herbs such as *Ischnea 9177, Gnaphalium 9205, Ranunculus* spp., *Lactuca 9193, Potentilla Forsteriana* var. *Keysseri* Diels, **P. habbemana* Merr. & Perry, *Gentiana 9180, Euphrasia 9192, Geranium papuanum* var. *alpestre* Ridl., *Plantago* spp., *Eriocaulon* spp., *Drosera 9195, Epilobium 9206* and *Halorrhagis 9194*, and *Sagina 9233* and *Centrolepis 9173* were common cushion plants. Although *Sphagnum* was usually absent, mosses such as **Bryum longidecurrens* Bartr., **Ectropothecium palustre* Bartr. and *Meesea triquetra* (Hook. & Tayl.) Aongstr. often took possession of seepage areas, and grey and black lichens and a dark brown hepatic were plentiful on the ground.

While common enough, generally grouped together, and showing a

preference for the drier ridges and banks of streams, shrubs were seldom conspicuous on the grasslands. Some, such as prostrate *Vaccinium ciliatipetalum* J. J. Sm. and *Styphelia Dekockii* J. J. Sm., were restricted to the short-grass mat, and *Rhododendron 10184* formed large cushions on wet ground. As shrubs of 25–50 cm., *Drimys 9068, Symplocos 9518, Eurya Brassii* Kobuski, *Hypericum Macgregorii* F. v. Muell. and *Tetramolopium 9349* occurred chiefly with the long-grasses, as did the fire-resistant tree-ferns *Cyathea tomentosissima* and *C. cheilanthoides,* abundant on ridges and along the streams.

Marshes of considerable extent spread back from the upper end, much of the south shore, and part of the northern bay of the lake. Forming a lipped edge where the marshes touched on the lake, were deep soft beds of peaty material which, when walked on, yielded as if afloat. The marsh vegetation consisted of a thick stand of *Deschampsia* and *Scirpus 9443,* a metre or more high. The outlet stream of the lake, which flowed wide and deep before dropping away in rapids, was also edged with *Scirpus* beds and tall *Carex 9211,* and contained quantities of submerged *Potamogeton 9513.* Plentifully tufted in sandy marginal shallows of the lake were *Isoetes 9441* and especially *I. 9440.*

Mount Wilhelmina

The route followed from Lake Habbema Camp to Mt. Wilhelmina led for three hours almost due south from the grass valley of the lake over a lightly timbered ridge and across the broad Balim-Wamena plain. From the Wamena River, which rises high on the north slopes of Mt. Wilhelmina, and was crossed at an altitude of 3150 m., a native path was followed in a general southeasterly direction on to a limestone ridge that carried forest dominated by *Podocarpus-Libocedrus* and superior to any near Lake Habbema, and into a narrow grass valley in which six hours of travel with carriers from the lake camp brought one to an altitude of 3400 m. There an intermediate transport camp, called Tusschen-bivak, was established. The stream that flowed past Tusschen-bivak disappeared in limestone in at least one place, and a half-hour below the camp the path skirted the brink of a large sinkhole, the upper sides of which exposed a deposit of what looked like glacial till. Prominent on the steep forested ridges that hemmed in the valley were the bunched crowns of slender *Schefflera* trees that stuck out like mops against the sky. Although no fresh soil exposures were observed, the forests evidently had suffered considerable disturbance from landslips, and the presence of numerous dead old conifers and well grown

young trees probably indicated that, many years before, parts of the forest were ravaged by fire.

Still leading approximately southeast from Tusschen-bivak, the native path climbed over a ridge into a smaller grass valley, from the head of which, at 3480 m., it dropped down into the long, grassy, north-south valley in which the mountain base camp was situated at 3560 m., 5½ carrier hours from Tusschen-bivak, and about 7 km. northeast of the summit of Mt. Wilhelmina. A half-hour below the camp, the stream that drained the valley passed underground through a low transverse ridge of limestone. This ridge, with a 50 m. precipice of limestone that crossed the valley within gunshot of the camp, formed a sheltered pocket about 1 km. long and half as wide, with high timbered ridges on both sides and a wet bottom in which were some open swamps to which innumerable slender grass tufts growing erect in the water gave the appearance of rice fields. Only one *Libocedrus* tree was seen after entering the valley. The limit of the conifers had been passed. The forests were getting lower, much cut by glades, and the tops of nearby 3900 m. and 4000 m. peaks were without trees. The camp was on a long slope of landslip debris covered with grass tussocks. Generally, the slopes were considerably disturbed by slips and subsidences, and the soil peaty and immature. Botanical collections were made here between September 7 and 16.

From a cavern at the foot of the limestone precipice, issued the stream that flowed down the base camp valley, and from the rim of the precipice the valley continued in a southerly direction toward the crest of the range. At 3650 m. was a lake, about 400 m. long and 300 m. wide, about which patches of forest had been burned and parts of the grassland appeared formerly to have been forested. From a rather marshy flat at the head of the lake a steep climb up a wooded sandstone declivity brought one, at 3800 m., to the open top of a rocky saddle, the crest of the range and the divide between the Balim waters and those flowing directly to the south. From here a view was had of the quick-falling southern slopes, a view limited by the projecting summit ridge of Mt. Wilhelmina, which towered parallel a kilometre still farther to the south and west. The path, which dropped to the south, was left at this point, and in a sheltered hollow at the foot of a waterfall 0.5 km. to the west, about 2 km. from the snow-capped summit of the peak, and three carrier hours from the 3560 m. Camp, a climbing base and the highest collecting camp was established at 3800 m. Above the waterfall, talus slopes of grey-white limestone on the south side of a V-shaped east-west valley gave the camp its name of Puindal or Scree Valley

Camp. On the north side of Scree Valley a ridge of largely bare sandstone rose in a false peak about 4300 m. high. On a saddle at the head of the valley, from which the north face of Mt. Wilhelmina proper rose in almost a sheer face of limestone to 4750 m., was a small lake at an elevation of 4150 m.

From Scree Valley Camp, between September 17 and 27, plant collections were made at altitudes up to 4300 m. on the summit ridge of Mt. Wilhelmina, down its south slopes to 4000 m., and down the waterfall creek to 3700 m. Some few plants occurred on the south slopes which were not found on the north side of the range.

Scree Valley Camp was at the highest elevation at which a few sticks long enough for tent poles could be had. From Lake Habbema up to the vicinity of the 3650 m. lake, the largest areas and best development of forest occurred in association with limestone. Above that, such forest as there was consisted of strips under sheltering bluffs and compact little clumps of trees on the rocky slopes and crests of ridges. Scattered, bushy tree clumps straggled up to about 4000 m. Absolute tree limit was reached at 4050 m., in the shelter of a north-facing sandstone bluff on the false peak. The only large woody plant above that level was *Coprosma 9939,* a shrub of 1–1.5 m., dotted over tussock grass slopes up to 4150 m. on the summit ridge of the mountain. This *Coprosma* ranged up to a similar level on the south slopes, where the last patch of stunted trees was at an altitude of 4000 m. The tussock grass *Deschampsia Klossii* Ridl. still flourished among limestone rocks at 4300 m. on the crest of the summit ridge. Under rocks at 4500 m. Archbold and Rand found the small grass *Festuca 10206* and tufts of *Oreomyrrhis? 10082,* the only flowering plants seen by them at that altitude. But on the false peak, tiny grey rosettes of *Plantago 10135* practically replaced even the ubiquitous dwarf grass *Monostachya oreoboloides* (F. v. M.) Hitchc. as low as 4150 m., where the most striking feature of the vegetation was the patched though abundant covering of brown, yellow and green bryophytes, including among mosses *Schlotheimia pilicalyx* Broth. & Geh., **Holomitrium cirrosum* Bartr., *Atractylocarpus dicranoides* Dix. and *Distichium capillaceum* (Hedw.) Bry. Eur., that grew on sheltered faces of the soft sandstone rock.

The path followed from the Wamena to near Scree Valley Camp bore signs of long use, and in several places was cut shoulder deep in the ground. Here and there, in the shelter of the forests, were native shelters, the better ones in the conifer zone made of *Libocedrus* bark. Higher up they were of boughs, treefern fronds and grass. From 3560 m.

upwards the natives camped under rocks, and built no shelters. In the ashes of such a rock camp under the cliff at 3560 m. were found charred fragments of human bones, and in a niche in the rock were parts of a skull and a femur, wrapped in bark.[1] A line of stones, laid along a comb of rock in the 3800 m. pass, marked the spot where the path topped the range. No native paths or camps were encountered above this altitude, and from the fact that, in Scree Valley, tin cans, a bottle stopper and other articles likely to be picked up by primitive people were found on the site of a camp used 13 years before by the Kremer Expedition, it would seem that the native travellers did not venture far from the path at this high crossing. Their motive in crossing the range could not be ascertained. Men, women and children, in parties of from four or five to over a hundred, made the journey, carrying bundles and sometimes leading pigs as though on a trading expedition, a visit to friends, or a dance on the opposite slopes. These journeys were carried out regardless of weather conditions. Hunting was not the object, although ducks were shot with bow and arrow on the lakes, and from Lake Habbema up to about 3600 m. on the range were found deadfalls made by the natives to catch the bandicoots (*Peroryctes*) and the very large rats (*Mallomys*) that inhabited the grasslands and forest borders.

A spell of very wet misty weather prevailed throughout the stay of the expedition at both camps on the slopes of Mt. Wilhelmina. These conditions, which curtailed all field activities and rendered impossible the ascent of the peak, began on August 31 and continued until October 7. Both grasslands and forests were in a state of constant saturation. On the rare clear mornings, when grass temperatures of minus 5° Centigrade were registered at the 3560 m. Camp, the trampled slush of the paths froze solid, and the bare rock of the summit ridge glistened white with ice. Snow, which normally covered but the tip of the peak, on one occasion lay as low as 4250 m. on its slopes. The following standard temperatures were recorded at the 3560 m. Camp from September 10 to 22, inclusive: maximum (8 readings) 10.5–17, mean 13.5, minimum (8 readings) minus 2 – plus 2.5, mean zero Centigrade.

But for a steady falling off in total number of species and the acquisition of a few new ones with increasing altitude, the forests of the Mt. Wilhelmina slopes were essentially similar to those of the Lake Habbema area, and **Vaccinium dominans* Sleumer continued in the role of a major dominant to near timber line. They differed chiefly in the absence of conifers which, having attained dominance at about

[1]The people of the Balim Valley cremate their dead.

3150–3200 m. on a limestone ridge above the Wamena River, dropped out of the picture at an altitude of approximately 3500 m. (The dominant position of *Podocarpus papuanus* Ridl. down to 3100 m. on the relatively warm slopes of the Bele River basin to the northeast of Lake Habbema was mentioned on page 278). The disappearance of the conifers was all the more remarkable in that their place as characteristic overtopping trees was usurped by the Araliaceae; first by *Schefflera 9091,* and above 3700 m. by *No. 9424,* which persisted to nearly 3800 m.

From about 3500 m. to 3700 m. on the slopes, **Vaccinium dominans* Sleumer dominated in dense, low, often wind-clipped forest, at most 5–6 m. high, in which *Rapanea 9936* became increasingly important with altitude and *Symplocos 9912, Eurya Brassii* var. *erecta* Kobuski, *Xanthomyrtus 9904, Vaccinium quinquefidum* var. *oranjense* J. J. Sm. and *Olearia 9968* occurred as minor dominants. *Saurauia 9952* grew on the face of the cliff at 3560 m. This forest was without woody climbers. In a sparse undergrowth there was but one shrub, *Vaccinium densifolium* J. J. Sm., and *Uncinia 9847* associated with occasional ferns such as **Hypolepis Archboldii* Copel., **Polystichum Archboldii* Copel., *Grammitis scabristipes* (Baker) Copel. and abundant creeping *Selliguea Feei* Bory in a thick cover of ground mosses. *Selliguea Feei* was also abundant as an epiphyte in the forest interior, pendent from the heavily moss-padded tree trunks in association with massed *Meringium Forsteri* (Ros.) Copel., **M. melanosorum* Copel., *Asplenium Brassii* C. Chr. and *Ctenopteris pendens* (Ros.) Copel., tufted *C. bipinnatifida* (Baker) Copel., *C. whartoniana* (C. Chr.) Copel., *Grammitis mollipoda* (Baker) Copel., *G. novoguineensis* Copel., **G. stomatocarpa* Copel., **G. plurisetulosa* and **Calymmodon fragilis* Copel. The few orchids, of which the fiery red *Dendrobium 9953* alone was conspicuous, occurred as small epiphytes about the edges with *Lycopodium 9896,* pendent *Galium 9859,* and the matted shrubs *Vaccinium oranjense* J. J. Sm. and *V. 9907.* Among hepatics and lichens on exposed upper branches were found **Ctenopteris Myer-Dreesii* Copel. and **C. fusca* Copel. Mosses, of which **Holomitrium cirrosum* Bartr., *Schlotheimia pilicalyx* Broth. & Geh., *Dicranoloma Blumii* (Nees) Par., *D. arfakianum* (C. M.) Broth. and *Macrothamnium hylocomioides* Bartr. were most abundant and characteristic among many species, predominated over hepatics on both trees and ground under the canopy of these upper subalpine forests. Conspicuous in the narrow marginal shrubberies, in which showy red or yellow *Rhododendron 9833* was characteristic, and ericoid *R. 9024* of Lake Habbema, *Styphelia nubicola* Wernh., *S. obtusifolia* var. *hypoleuca*

J. J. Sm., *Vaccinium densifolium* J. J. Sm., *Olearia 9832, Pittosporum pullifolium* Burk. and brownish *Coprosma 9842* (which appeared at 3400 m.) also plentiful as shrubs of 1–2.5 m., were **Cyathea tomentosissima* Copel. and almost glabrous *C. Muelleri* Baker, which largely replaced it at this altitude. Gregarious in the shrubberies were the erect ferns *Blechnum Hieronymi* Brause and *Hymenolepis revoluta* Bl., and **Potentilla novoguineensis* Merr. & Perry, *Keysseria 9837, Veronica 9861* and **Trigonotis abata* Johnst. entered from the grassland.

In the highest strip of real forest, that at Scree Valley Camp, tree species were reduced to five—**Vaccinium dominans* Sleumer and *Rapanea 9936* in control, *Drimys 10111, Olearia 10110* and *Pittosporum pullifolium* Burk. (commonly arborescent). Very heavily mossed on trees and ground with chiefly **Macromitrium Archboldii* Bartr. and **Holomitrium cirrosum* Bartr., the epiphytic flora consisted of *Meringium Forsteri* (Ros.) Copel., **Calymmodon fragilis* Copel., **Grammitis plurisetulosa* Copel., **G. debilifolia* Copel. and *Selliguea Feei* Bory, all common, and the latter the only ground fern. In the border shrubberies were *Rhododendron 9833, Coprosma 9842, C. 9939, Styphelia obtusifolia* var. *hypoleuca* J. J. Sm., *S. nubicola* Wernh. and *Symplocos 9937*. The bushy tree clumps above about 3900 m. were of *Rapanea* and *Drimys,* which, stunted to shrubs, formed with *Rhododendron 9833* and *Coprosma 9939* the scattered scrubs in which forest species reached their uppermost limit at 4050 m.

Up to the highest levels examined on Mt. Wilhelmina, the grasslands retained the general characteristics presented at Lake Habbema. *Deschampsia Klossii* Ridl. maintained its position as major dominant of the long-grass community, and *Monostachya oreoboloides* (F. v. M.) Hitchc. was chief dominant of the short-grass community. The Mt. Wilhelmina grasslands were, however, much richer in species. While certain plants of the lower levels dropped out on the slopes, there was nevertheless a steady gain in the total number of herbs and particularly of Compositae and grasses up to about 4000 m., above which elevation few new elements appeared and species diminished rapidly in number and for the most part also in abundance. A noteworthy feature was the part played by mosses, massed in brown or yellow cushions or distributed through the grasses, many of which also occurred in the forests. Among the most remarkable mosses were *Tetraplodon Lamii* Reimers, generally found on the faeces of wild dogs, and **Holomitrium austroalpinum* Bartr., which formed, usually on the bleak crests of ridges, knee-high cylindrical cushions that reminded one of the distance markers along a highway.

In the long-grass community *Gahnia 9047* occurred about forest edges up to about 3700 m., and co-dominant, locally dominant or associate grasses with the *Deschampsia* included *No. 9928, No. 9945, Festuca nubigena* Jungh., *Calamagrostis Brassii* Hitchc., *Hierochloë redolens* R. Br., *Poa Brassii* Hitchc. on forest edges, *Brachypodium pubifolium* Hitchc., and *Danthonia Archboldii* Hitchc. With *Monostachya oreoboloides* as co-dominants were *Poa crassicaulis* Pilg. and *Oreobolus 9244*. Among herbs, most of which occurred in association with both long and short grasses, were cushioned *Potentilla Forsteriana* Lauterb. var. *Keysseri* Diels, *Astelia 9188, Centrolepis 10022* and *Eriocaulon 9956, Keysseria 9837, K. 10208, *Trigonotis abata* Johnst., *T. papuana* (Hemsl.) Johnst., *Veronica 9861, Trachymene 10019, Gentiana 9990, G. 9866, Euphrasia 9971, Papuzilla 10053* (above 3800 m.), *Ranunculus 10220, R. 9867, *Potentilla Archboldii* Merr. & Perry, **P. Brassii* Merr. & Perry, *Pilea 10242*, several *Plantago* spp., *Ischnea 10039, Gnaphalium 10216* and numbers of other dwarf Compositae.

Restricted to the grassy banks of streams were **Wahlenbergia confusa* Merr. & Perry (up to 3500 m.), *Oxalis magellanica* Forst., *Nertera 9397* and *Geranium monticola* Ridl. Common lithophytes included massed and pendent *Epilobium 10015* and *Coprosma 9831* (a shrub) up to 3600 m., *Papuzilla 10053*, and the ferns *Polystichum alpinum* C. Chr., **Blechnum nudius* Copel. and *Mecodium ooides* (F. v. M. & Baker) Copel. Pioneers of the screes at 3900 m. to 4100 m. included tufted *Anaphalis 10048* and *Epilobium 10043*, and a notable group of prostrate and ascending, pubescent, semi-woody small Compositae (*Tetramolopium?*), e.g. *No. 10047, No. 10049, No. 10050*, also found on weathering rock surfaces. Common as weeds of the native rock shelters were *Agrostis retrofracta* Willd., Urticaceae *9826* and robust *Anaphalis 10115*.

As grassland shrubs up to 1 m. high, *Symplocos 10127* and *Eurya Brassii* var. *erecta* Kobuski, and *Rhododendron 10184* in large cushions, were common up to about tree limit, and *Coprosma 9939*, as already mentioned, conspicuous as a larger shrub up to 4150 m. Between the upper limit of the *Coprosma* and the 4300 m. level several *Hebe* spp. (a genus which first appeared at 3440 m.), *Tetramolopium 10183* and *Styphelia obtusifolia* var. *hypoleuca* J. J. Sm. occurred abundantly as shrubs of 20–30 cm., and among Rhododendrons, a genus richly represented in the alpine and subalpine zones, may be mentioned *R. 9917* with showy red flowers, and the striking red and yellow *R. 9916*.

The tree-fern *Cyathea Muelleri* Baker, of which only one clump was seen at Lake Habbema, became very abundant with **C. tomentosissima* Copel. on the grasslands and especially in forest-bordering shrubberies

and forest burn communities at about 3500 m., but both reached the extreme upper limit of their range at 3700 m.

Effects of Fire at High Altitudes

No fire destructive to forest had occurred in the Lake Habbema area or on the slopes of Mt. Wilhelmina for some years prior to the visit of the expedition. A fire lit by natives at Lake Habbema, during the stay of the expedition, swept over several acres of long grass and, burning to the forest edge on a 200 m. face, no more than scorched the bordering shrubs. Another fire, which entered some low-tree thickets, completely denuded the trees of leaves, but burned only the surface of the deep ground moss. There was no opportunity to observe whether the trees lived or died after the latter fire. But wherever there were grasslands, from Lake Habbema up to an elevation of 3650 m. on Mt. Wilhelmina, there was abundant evidence of former fires destructive to forest, affecting in all cases only small areas, and always close to native paths.

The remarkably hardy native travellers who, naked, or with at most a hood of *Pandanus* leaves covering head and shoulders, journey over the highlands, move at a smart pace and make frequent stops to rest. The prevailing temperatures are such as to encourage haste, while the rarity of the air makes long continued exertion impossible. In forest, natural glades are used as resting places and sites for shelters, or clearings made for the purpose. Out on the grasslands, the travellers halt where fuel is to be had from tree-ferns or some timber patch, and wherever they stop they build a fire. These fires are left burning when the party moves on, and sometimes the grass is fired by hunters in pursuit of game. The absence of large quarry in this area would, however, argue against any great activity on the part of hunters in intentionally starting fires.

The peaty character of the soil on the highlands of the Snow Mountains and the weather experienced at Lake Habbema, where a camp was maintained for four months (July 20–November 18) in the southeast season or "dry monsoon," point to the area being climatically wet. Forest fires probably occur only in exceptionally dry times. Then the long-grass community, from its proximity to the forests, where it attains its maximum development in the forest zone, must constitute a very definite fire hazard, against which the chief protection of the forests would lie in their border shrubberies, which, by retarding air movement and evaporation, would help to keep the bryophytes of the interior in a condition too moist to burn. Macgregor,[1] in describing a fire which

[1]Annual Report, British N. Guinea 1889–1890: 43.

occurred at an altitude of about 3100 m. on the Owen Stanley Range and in a few minutes "swept like a tornado" over scores of acres of grassland, mentioned that "the surrounding forest growth, although it looked very dry, did not burn."

Since the natives frequently carry wood to some open spot and there light their fires, the presence of charcoal and fragments of charred wood on these much travelled grasslands is not a reliable indication of the former existence of forest in places where such traces of fire are found. Bits of charcoal and charred wood are seen in places distinctly unfavourable for the development of forest or the growth of trees. The distribution of trees within altitudes corresponding with the range of the conifers would appear to a very large extent controlled directly by local climate, and that of closed tree communities, that is, communities capable of carrying destructive fires, by edaphic conditions. *Libocedrus* forms open stands where the soil will not support any other kind of tree, where even shrubberies seem unable to develop, and where the long-grasses — the only grasses which will carry fire — yield control of the habitat to the dwarf species of the bog turf. But rarely will one find even a *Libocedrus* in any stage of growth, and never a mature tree, out in the broad hollows and valleys. Yet, on the well drained soil of the banks of streams in these cold hollows and valleys the long-grasses grow rankly in closed stands, and there, too, is found an abundance of tree-ferns. The long-grasses cover marshes and quaking bogs as well as the driest grassland soils. The primary habitats in which the tree-ferns thrive best are the long-grass community, as developed on good soil on the banks of streams and about forest edges on the ridges, and the forest border shrubberies. Their soil requirements apparently are very close to those of the closed tree communities. The destruction of forest by fire, by leaving open to invasion soils peculiarly suited to them, affords the tree-ferns an opportunity to extend their territory. They may occur in large numbers on denuded forest land. Above the conifer zone, except for some scattering among rocks, all but relic trees occur in closed communities which, as the severity of the climate increases with altitude, become proportionately more exacting as to soil conditions. At their upper limit imposed by climate, trees are to be found only on the warmest and driest soil in the most sheltered positions available.

Old specimens of *Podocarpus papuanus* Ridl., which seems better able to withstand fire than *Libocedrus* but is apparently unable to reproduce itself under grassland conditions, often occur as forest relics in long-grass adjacent to standing forest. In the absence of dead or relic

trees, abundant charcoal, and of course forest regenerative communities, tree-ferns when growing in numbers on ridges may be looked upon as possible indicators of deforestation by fire.

Much has been written regarding the difficulty high-mountain forest has in maintaining itself when in contact with grassland, and there are known instances of its disappearance from mountain tops as a result of fire. Lane-Poole[1] has mentioned extensive deforestation by hunter's fires on Mt. Sarawaket in Northeastern New Guinea, and figured burnt edges of *Dacrydium-Libocedrus* forest and tree-ferns growing on grass slopes rising from what would appear to be natural open hollows. The Archbold Expedition of 1933–34, of which the writer was a member, found the top of the Wharton Range largely deforested and covered with tussock grass (*Danthonia Archboldii* Hitchc.) and tree-ferns (*Cyathea Macgregori* F. v. M. and *C. gleichenioides* C. Chr.) from Murray Pass west to Mt. Albert Edward. At 3300 m. one great fire had, a few years before, completely destroyed the *Podocarpus-Libocedrus* forest over an area of several square miles. The tussock grass was establishing control in a burn community of annuals characterized by *Poa longiramea* Hitchc. and *Epilobium* sp., and although forest second growths were obviously at a disadvantage in competition with the grasses, young thickets of *Coprosma papuensis* were making good headway in parts. Of an estimated 50 sq. miles of grassland above 3500 m. on Mt. Albert Edward, probably only one-third could be considered a primary condition. This section of the central range appeared to have a much drier climate than the Snow Mountains. Wallabies and wild pigs were plentiful on the grasslands and extensively hunted by people living on both sides of the range. The forests of the broad crest of the range were well on the way to eventual extermination.

A different state of affairs obtained about Lake Habbema and on Mt. Wilhelmina. Such fires as had occurred there recently enough for their limits to be defined with certainty, by the presence of dead trees and by other means, had affected only small areas. The fires as a rule were not stopped by any natural barrier; they burned themselves out in forest. On some of these areas scattered or clumped shrubs and numerous tree-ferns grew in a dense cover of long grass that, perhaps after a succession of fires, had taken possession. Most of the burned forest areas carried, however, vigorous regenerative communities. In the conifer zone, succession was initiated by shrubs of the primary forest borders, such as *Drimys, Styphelia, Rhododendron* and *Coprosma* with, between them, *Tetramolopium* from the grasslands, *Selliguea Feei* on the ground, and sometimes *Rubus* and young tree-ferns. *Libocedrus*

[1]Forest Resources of the Territories of Papua and New Guinea, 65, 66. 1925.

regenerated freely on formerly forested ground that had gone to grass, and in some instances shrubs pushing out from the edge of neighbouring forest were slowly re-establishing forest conditions. Above the conifer zone, the forest secondary communities were mainly of *Coprosma* spp., with which, up to about 3650 m., were associated a great many treeferns.

A general view of the area leaves the impression that the forests of Lake Habbema and Mt. Wilhelmina have succeeded in maintaining themselves very well over what must have been a long period of disturbance by the fires of native travellers. Forest in some form or other still occupies by far the greater part of the area assumed capable of supporting forest.

MAJOR PLANT COMMUNITIES

Several botanists with field experience in New Guinea, notably Lauterbach[1] for localities including the Sattelberg Mountains in Northeastern New Guinea and Gibbs[2] for the Arfak Mountains in Netherlands New Guinea, have given detailed accounts of the vegetation in which local altitudinal zonation received attention. Lam[3] in 1934 published a preliminary floristic review and the first vegetation map of the island. Bohrer[4] has recently produced for the Territory of Papua a very detailed vegetation map compiled from Government patrol reports and other literature, which, like that of Lam, necessarily leaves much to be desired from the point of view of accuracy, and must be regarded, as indeed both maps are advanced as, preliminary and approximate.

The first to attempt a classification of the major plant communities of New Guinea as a whole was the forester Lane-Poole,[5] who, in his report on the forests of the two eastern Territories, distinguished the following "forest regions," defined by climate and altitude: —

Savannah forests		
Lowland forests	0– 1,000 ft.	(0– 300 m.)
Foothill forests	1,000– 5,500 ft.	(300–1700 m.)
Mid-mountain forests	5,500– 7,500 ft.	(1700–2250 m.)
Mossy forests	7,500–11,000 ft.	(2250–3350 m.)
High-mountain forests	over 11,000 ft.	

[1]Bot. Jahrb. **62**: 284–304, 550–569. 1928; **63**: 1–28, 419–476. 1929.

[2]A Contribution to the Phytogeography and Flora of the Arfak Mountains, London. 1917.

[3]Blumea **1**: 115–159. 1934.

[4]"Papua" Physische Landeskunde von British Neuguinea, Frankfurt. 1939.

[5]l. c. p. 4 et seq.

Lane-Poole described the savanna-forests as "open forests, similar to the large areas that occur in Australia," consisting chiefly of *Eucalyptus* spp. His lowland forests are the mixed rain-forests. Of his foothill forests he writes (p. 33): "They lack character, and at times seem only a degenerated form of the rain forests of the lowlands; the same species keep cropping up, and the only difference is that the foothill rain forest is a pole wood, or at best an assembly of low, small-girthed trees. One has just decided that such is the case, and is beginning to ascribe reasons for the low quality of the rain forest, when patches of purely foothill species are met with, and the rain forest becomes quite dominated by what is certainly a different type of woodland." He considered *Quercus Junghuhnii* Miq. (*Castanopsis Junghuhnii* (Miq.) Mgf.) the most characteristic foothill tree, and stated that a marked overlap of other oaks and also *Araucaria* spp., from the mid-mountain forest, may occur. The mid-mountain forest is described (p. 35) as "climatically very well defined, so far as its lower limits are concerned, for it corresponds to the cloud belt," and is characterized by oaks of several species and *Araucaria Cunninghamii* Ait. *Podocarpus thevetiifolius* Zipp. and *Xanthomyrtus longicuspis* Diels are stated to form over 80 per cent. of the mossy-forest stocking on Mt. Obree. The high-mountain forests are described as forests of *Podocarpus, Dacrydium, Phyllocladus,* and a few non-coniferous trees.

Lane-Poole rejected as inapplicable the term "alpine" for the extensive grasslands seen by him on the upper parts of Mt. Sarawaket (4100 m.). "There is no doubt in my mind," he wrote (p. 180), "that, except for the very marshy land and the actual cliffs and outcrops of limestone, the whole of this mountain top was under a forest of conifers and myrtles," which had been denuded and burned to grass by the natives.

Van Steenis,[1] in the second part of his monumental work on the origin of the Malaysian mountain flora, has proposed the following altitudinal zones for the region, arrived at by the statistical analysis of collections of mountain plants: —

0–1000 m.	Tropical zone
500–1000 m.	Colline subzone
1000 2400 m.	Montane zone
1000–1500 m.	Submontane subzone

[1] Bull. Jard. Bot. Btzg. III. **13**: 289–417. 1935.

(Continued)

2400–4000 m.	Subalpine zone (up to tree limit)
4000–4500 m.	Alpine zone (tree limit to climatic snow line)
4500 m.–upwards	Nival zone

Elsewhere,[1] van Steenis advances the opinion that savannas are not a natural vegetation, but the result of continuous burning. His colline subzone would appear to correspond to the foothill forest zone of Lane-Poole.

Following is a summary of the major plant communities recognized by the Archbold Expedition of 1933–34, which worked in the semi-arid areas of Port Moresby and the Oriomo River, and from two lowland and six mountain camps on a cross section of the south slopes of the central range from Hall Sound to the summit of Mt. Albert Edward. In the Port Moresby area, savanna and savanna-forest, grassed with *Themeda triandra* Forsk. and timbered with *Eucalyptus* spp., extended from the coast to an altitude of at least 600 m. on the Astrolabe Range. Similar savanna grasslands occupied a large extent of country and reached an elevation of 130 m. behind a forested coastal fringe to the northeast of Hall Sound. The Oriomo River flowed through a vast area of savanna and savanna-forest, extending from the Fly River west into Netherlands territory, on which grasses of several genera dominated the ground cover, species of *Tristania* and *Melaleuca* were the principal trees, and *Eucalyptus* also occurred. In contact with savanna on dry coastal hills about Port Moresby, and also behind Hall Sound, was a forest characterized by deciduous trees such as *Gyrocarpus americanus* Jacq. and *Bombax malabaricum* L., to which the term monsoon-forest should perhaps be applied. Mixed rain-forest occurred in isolated patches and in strips along streams in the semi-arid areas and replaced the savanna vegetation of the Port Moresby and Hall Sound districts as rainfall increased inland. This forest, the greatest of all in respect of area in New Guinea, covered the climatically wet lowlands and foothills and pushed up the mountain valleys and ravines to elevations of 2400 m. on Mt. Tafa Range and 1800 m. or more on the Wharton Range. Next above the rain-forest in altitudinal sequence was a less mixed forest, at first nearly a pure stand of *Castanopsis Junghuhnii* (Miq.) Mgf., very open under the canopy, with above it a second association dominated by oaks and containing quantities of *Engelhardtia*

[1]Bull. Jard. Bot. Btzg. III. **14**: 50–55. 1936.

sp. *Araucaria Cunninghamii* Ait. was common, sometimes plentiful, above about 1200 m. This fagaceous forest first appeared at 480 m. on the outer spurs of the mountains. In the Vanapa Valley, under the lofty Wharton Range, it had occupied originally a broad band between altitudes of about 1500 m. and 2000 m. on south-facing slopes, and occurred in patches up to 2350 m. on north-facing slopes. In the Vanapa Valley, and also the valley of the Auga River, this and the upper rain-forest had largely disappeared and been converted to grass by big native populations. Above the main body of the oak-*Castanopsis* forest on the Wharton Range, and especially on the north face of Mt. Tafa Range or the south side of the Vanapa Valley, was a very tall forest dominated by *Nothofagus* sp., which was examined between levels of 2100 m. and 2300 m. and probably extended higher and lower on the slopes. Forests of *Xanthomyrtus* spp. and *Phyllocladus protractus* Pilg., stunted and very mossy on exposed crests, elsewhere tall and not heavily mossed, clothed the upper slopes and the summit of Mt. Tafa Range (2800 m.) and followed its southern spurs down to 1500 m., and on the Wharton Range extended from about 2400 m. on south-facing slopes up to 3200 m. on its crest. From 3200 m. on the Wharton Range up to tree limit at 3850 m. on Mt. Albert Edward, and appearing as low as 3000 m. on wet ground, were forests at first dominated by *Podocarpus papuanus* Ridl. and *Libocedrus papuana* F. v. M., and at higher altitudes by *Vaccinium* sp. with the conifers rising in an open stand above the canopy. Grasslands populated by alpine species were first met with at 2750 m. on deforested parts of the Wharton Range, and there were natural glades in *Xanthomyrtus-Phyllocladus* forest as low as 2900 m. The subalpine forest of conifers and *Vaccinium* had always been considerably interrupted by grassy glades, hollows and lake basins, and probably one-third of the extensive open highlands between the 3500 m. level and the 3980 m. summit of Mt. Albert Edward were under a primary cover of grasses.

The above interpretation of major communities shows several points of difference from that of Lane-Poole. In the first place, there is the monsoon-forest, which Lane-Poole described (l. c. p. 5) and considered intermediate between rain-forest and savanna-forest. Secondly, since the foothill forest described by Lane-Poole appears to comprise parts of the upper rain-forest and what should best be considered the lower part of his mid-mountain forest, it has not been possible to distinguish it as a distinct unit. Thirdly, although now known from localities 900 km. apart and probably distributed over all the island, hitherto the *Nothofagus*-forests have gone unrecognized, and this is the first report

of their existence in New Guinea. Finally, the alpine grasslands encountered by the Archbold Expedition of 1933–34 are considered, in part, primary, and an expression of the climate.

On the other hand, all but three of the major plant communities encountered by the Archbold Expedition of 1933–34, viz. savanna, monsoon-forest and *Xanthomyrtus-Phyllocladus* "mossy forest," have their counterpart in the Netherlands New Guinea territory examined by the 1938–39 expedition, and are described in this paper. The wet lowland climate is sufficient explanation for the absence from this area of savanna and monsoon-forest, such as is found in semi-arid parts of New Guinea. There is no such convenient circumstance to explain the absence of the third community, which is doubtless the "mossy forest" of Lane-Poole. The generic dominants, it is true, occur commonly as subsidiary trees or as minor dominants in the *Nothofagus*-forest as found in Netherlands territory, and they enter the subalpine forest of the Snow Mountains, but there the *Xanthomyrtus-Phyllocladus* forest can not be distinguished as a distinct community.

Only two well marked climatic types of vegetation occurred in the area visited by the Archbold Expedition of 1936–37, namely, rain-forest and savanna.

The observations of the writer in both east and west New Guinea suggest some modification and emendation of the classification of major plant communities proposed by the pioneer investigator Lane-Poole. These suggestions are advanced without any pretence to an understanding of the ecological factors responsible for the differentiation of most of what are believed to be well defined and, if the statement may be risked, climatic plant formations. Lane-Poole stressed the lower limit of the daily cloud accumulation on the mountains as defining the lower bounds of his mid-mountain forest. The writer, in 1933–34, noted that the lower edge of the afternoon cloud banks, which formed between 2 p.m. and 5 p.m., marked almost exactly, in an oblique line ascending with the mountains, the lower limits of this same forest if taken to include the forest characterized by *Castanopsis*. Also, the *Xanthomyrtus-Phyllocladus* mossy-forest was observed to be generally under cloud by 10 a.m. or noon. Yet, on the mountains rising from the Meervlakte, in Netherlands New Guinea, the *Nothofagus*-forest descended just to the lower edge of the clouds that formed about the middle of the forenoon, and this also seemed to hold good in the valley of the Balim. In east New Guinea, the writer found the line of demarcation between rain-forest and mid-mountain forest to coincide with an abrupt change from greyish and often rather rubbly soil to a deep reddish soil, but this was seldom the case in Netherlands New Guinea.

Since actual levels are likely to be of more practical use to the field botanist and the plant geographer than average levels, the elevations between which the communities have been observed in control are given in the following table. The upper limit of 1700 m. for savanna vegetation is from an observation by Lane-Poole:—

Savanna and savanna-forest	0–1700 m.
Monsoon-forest	0– 450 m.
Rain-forest	0–2400 m.
Mid-mountain forest	480–2350 m.
Beech-forest	850–3100 m.
Mossy-forest	1500–3200 m.
Subalpine forest	3000–4050 m.
Alpine grassland	2900 m. up to permanent snow line

To a large extent the species and in some cases even the genera of the dominant and characteristic constituents of the various communities as represented in the collections of the Archbold Expeditions are taxonomically undetermined. From these collections it is, however, possible briefly to define the communities as to dominants.

Savanna and Savanna-forest: The savannas and savanna-forests of the semi-arid areas differ only in tree spacing. The grasses and trees are the same, and the former are here regarded as the community dominants. The essential characters persist through wide variations in type due to local edaphic and zonal and regional climatic conditions. A treeless condition may generally be explained by an excess of ground water in the wet season. The savannas occupy about 3 to 4 per cent. of the area of New Guinea. They occur under a climate marked by pronounced wet and dry seasons, with a low to rather high annual rainfall of less than 1000 mm. to over 2300 mm. The deforested valleys at elevations of about 1000–2500 m. in the mountains are occupied by grasses of this community. Grasses: *Themeda, Ischaemum, Manisuris, Ophiurus, Imperata, Germainia, Heteropogon, Pollinia.* Trees: *Eucalyptus, Melaleuca, Tristania, Acacia, Banksia, Grevillea, Casuarina, Parinarium, Albizzia, Petalostigma.* Small areas of palm (*Livistona*) and *Pandanus* savanna occur to the west of the Fly River. According to Lane-Poole, *Eucalyptus* is absent from the apparently natural savannas of the northeast coast.

Monsoon-forest: Developed in the semi-arid areas and of limited extent. Dominants deciduous or evergreen, undergrowth chiefly woody and more or less sclerophyllous. Chief dominants: *Gyrocarpus, Bombax, Aleurites, Cochlospermum, Alstonia, Lagerstroemia, Albizzia, Semecarpus.* Undergrowth: *Flueggea, Harrisonia, Ehretia, Murraya.* A bamboo substage is sometimes developed in this and the drier rain-forests.

Rain-forest: Developed chiefly on the humid lowlands and lower mountains, these well known forests thrust outliers far up the cool mountain valleys, occur in the semi-arid areas in edaphically favourable situations such as the banks of streams, and supply probably 70 to 80 per cent of the vegetation cover of the island. Owing to the varied conditions under which they occur, they are very diversified in character, and not necessarily very mixed as regards dominants, or structurally complex, or rich in woody and herbaceous undergrowth, lianes and epiphytes. Important climax dominants include species of *Syzygium, Elaeocarpus, Terminalia, Intsia, Pterocarpus, Octomeles, Sloanea, Canarium, Myristica, Calophyllum, Garcinia, Dysoxylum, Pometia, Dracontomelum, Wormia* and Dipterocarpaceae. Subseral dominants: species of *Macaranga, Homalanthus, Saurauia, Ficus, Callicarpa, Glochidion, Trema,* etc., which seldom if ever occur in climax forest.

Mid-mountain forest: Best developed on smooth slopes in broad valleys, this forest is characterized by the high degree of dominance attained by few species. In its most distinctive form it is rather low in stature, dry-appearing, open under the canopy, deficient in undergrowth, and with few lianes or epiphytes; or it may be tall, moist, and not readily distinguished from some types of rain-forest. The largest native populations in the interior of New Guinea are centered in this forest zone, and little of the forest survives in the heavily populated valleys. Climax dominants: *Quercus* sens. lat., *Castanopsis* and *Engelhardtia. Araucaria Cunninghamii* Ait. occurs, often in great numbers, as an outstanding tree upwards of 50 m. high, or twice the height of the dominants. Subseral dominants, none of which occur in climax forest, include *Vaccinium* spp., *Grevillea subargentea* C. T. White, *Casuarina* and *Albizzia,* and *Cyathea contaminans* (Wall.) Copel. is a characteristic tree-fern.

Beech-forest: Usually a practically pure forest of *Nothofagus* spp., up to 40 m. high on sheltered slopes, and on exposed spurs reduced to scrubs. A forest with a generally rich and conspicuous bryophyte flora in which hepatics predominate, and very heavily "mossed" on both trees

and ground when of stunted growth. Native populations have considerably disturbed the lower parts of this forest, but cultivation and deforestation come to an end with the development of a peaty top soil at higher levels. In potential commercial value, the beech-forests probably exceed all others in New Guinea as a source of durable hardwoods. Subseral dominants, most of them derived from the lower layers of the primary forest, include species of *Rapanea, Quintinia, Drimys, Eurya* and *Kania.*

Mossy-forest: Like the beech-forests, which appear to have replaced them in the area examined in the Snow Mountains, the mossy-forests may be tall and not conspicuously mossed, or in exposed positions stunted to the form of heavily mossed scrubs. The "mosses" are chiefly hepatics. A dense, impenetrable undergrowth of scrambling bamboo is often present. Chief climax dominants: *Xanthomyrtus, Phyllocladus* and, according to Lane-Poole, *Podocarpus thevetiifolius* Zipp. Subseral dominants on Mt. Tafa and the Wharton Range include *Olearia, Rhododendron, Rapanea, Elaeocarpus, Archboldiodendron, Alphitonia* and *Homalanthus,* derived in part from the primary forest.

Subalpine forest: A forest dominated at its lower levels by *Podocarpus papuanus* Ridl., *Libocedrus* and, according to Lane-Poole, *Dacrydium* sp. *Vaccinium* spp., which characterize a subsidiary layer of low trees at the lower elevations, attain general dominance as the conifers thin out and finally disappear with altitude. A rich and abundant flora of bryophytes is characterized by hepatics in the conifer zone and by mosses in the *Vaccinium* zone. Subseral dominants: *Coprosma, Drimys, Styphelia, Rhododendron* and *Cyathea,* chiefly derived from the shrubberies that border the primary forest where it touches on the alpine grassland.

Alpine grassland: As in the case of the savanna grasslands of low altitudes, with which they have not a single species and but few genera in common, the alpine grasslands are developed under a rigorous climate, and edaphic conditions are important in determining their relationships with the contiguous forests. Dominants: chiefly *Monostachya, Aulacolepis, Deschampsia, Danthonia* and Cyperaceae. Other characteristics include *Potentilla, Ranunculus, Eriocaulon, Plantago, Astelia, Centrolepis, Epilobium, Gentiana, Ischnea* and *Euphrasia* as herbs, *Tetramolopium, Hebe, Rhododendron, Styphelia, Vaccinium, Eurya* and *Kelleria* as shrubs, and peculiar species of *Cyathea* as tree-ferns.

EXPLANATION OF PLATES

PLATE I

FIG. 1. Aerial photograph of the crest of the Snow Mountains, looking west over Mt. Wilhelmina towards Mt. Carstensz from a position above the 3800 m. Camp (X) of the expedition. Behind the camp is Scree Valley, with a small lake at its head, the limestone summit ridge to the south, and the sandstone false peak to the north.

FIG. 2. Aerial photograph of the Grand Valley of the Balim River, from a position near the meeting place of the Teerink and van Arcken patrols. Most of the tree growths are secondary forests of *Casuarina*. The approximate position of the expedition's 1600 m. Camp marked X.

PLATE II

FIG. 1. Strips and patches of *Vaccinium-Rapanea* subalpine forest at 3800–3900 m. on the north slope of Mt. Wilhelmina. *Coprosma 9939* grows among tussocks of *Deschampsia Klossii* Ridl. in the foreground. In the background is the eastern termination of the summit ridge, and in the lower left the 3800 m. Camp.

FIG. 2. Interior of the strip of *Vaccinium-Rapanea* forest shown in the right foreground of Fig. 1. Mosses, hepatics and *Meringium Forsteri* (Ros.) Copel. cover trees and ground. *Selliguea Feei* Bory appears in the ground moss on right, and *Styphelia nubicola* Wernh. forms the inner part of the border shrubbery on left.

PLATE III

FIG. 1. Mt. Wilhelmina viewed over the expedition camp on Lake Habbema from an altitude of 3265 m. on the rim ridge of the Grand Valley. *Podocarpus papuanus* Ridl. and *Libocedrus* sp. protrude above a patch of closed *Vaccinium* forest in the foreground. The ridges about the lake carry an open stand of *Libocedrus* growing in *Rhododendron* shrubberies and low-tree thickets.

FIG. 2. A grassy hollow, and ridges covered with closed subalpine forest of *Vaccinium, Podocarpus* and *Libocedrus,* at an elevation of 3230–3250 m. on the north side of Lake Habbema. The tree-fern *Cyathea tomentosissima* Copel. lines the banks of an entrenched stream, and between the stream and the forest is a patch of newly burnt grass.

PLATE IV

FIG. 1. View over the Bele River valley from an altitude of 2350 m. on the slope opposite the 2200 m. Camp. *Nothofagus* forests cover both slopes, and *Engelhardtia* sp. and two species of oaks grow on

the edge of the clearing in the foreground. *Imperata* grasslands and forest secondary communities surround the native hamlets and gardens.

FIG. 2. View north over the Grand Valley of the Balim, from a position just below the 1600 m Camp. Stone garden walls pattern the valley floor and the deforested limestone range rising to about 2400 m. across the river. The tree growths consist of mixed secondary communities in the foreground, a relic gallery strip of primary *Castanopsis* forest at the foot of the foreground slope, and Casuarinas on the valley bottom.

PLATE V

FIG. 1. Typical tall forest of *Nothofagus 11115* at 2450 m. in the Bele River valley. Most of the undergrowth and the smaller trees have been removed by the natives as a preliminary to felling the forest.

FIG. 2. "Mossy" low forest of *Nothofagus 13147* at an elevation of 900 m., 4 km. southwest of Bernhard Camp. *Pandanus leptocaulis* Merr. & Perry appears in the undergrowth. Hepatics form most of the thick bryophyte cover on trees and ground.

PLATE VI

FIG. 1. Expedition camp in flood plain rain-forest at 850 m. on Araucaria Creek, 4 km. southwest of Bernhard Camp.

FIG. 2. View northeast over the Meervlakte and the Idenburg River from the 2150 m. Camp of the expedition.

(Photographs by Archbold Expeditions)

PLATE VII

Map of the area visited by the Indisch-Amerikaansche Expeditie to Netherlands New Guinea, showing land routes, camps, and the route followed on aerial transport flights.

AMERICAN MUSEUM OF NATURAL HISTORY,
NEW YORK.

Figure 1

Figure 2

The 1938-39 Expedition to the Snow Mountains, Netherlands New Guinea

FULL-TONE — MERIDEN

Figure 1

Figure 2

The 1938-39 Expedition to the Snow Mountains, Netherlands New Guinea

FULL-TONE — MERIDEN

Figure 1

Figure 2

The 1938-39 Expedition to the Snow Mountains, Netherlands New Guinea

FULL-TONE — MERIDEN

Figure 1

Figure 2

The 1938-39 Expedition to the Snow Mountains, Netherlands New Guinea

FULL-TONE — MERIDEN

Figure 1

Figure 2

The 1938-39 Expedition to the Snow Mountains, Netherlands New Guinea

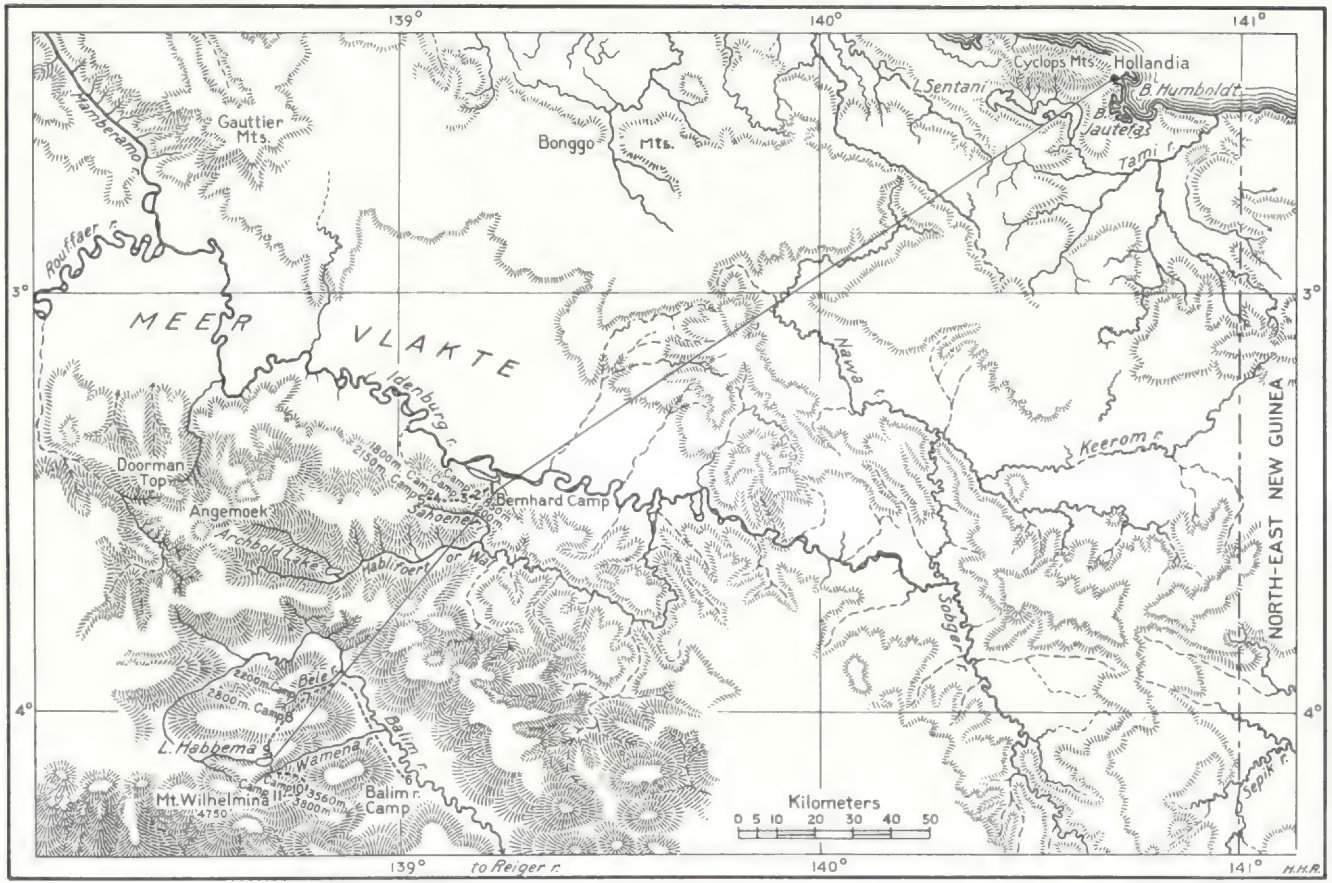
FULL-TONE — MERIDEN

FIGURE 1

FIGURE 2

THE 1938-39 EXPEDITION TO THE SNOW MOUNTAINS, NETHERLANDS NEW GUINEA

FULL-TONE — MERIDEN



The 1938–39 Expedition to the Snow Mountains, Netherlands New Guinea

STUDIES OF PAPUASIAN PLANTS, III*

A. C. Smith

GUTTIFERAE

The most essential treatments of Guttiferae, for a study of the Papuasian species, are those of Vesque (in DC. Monogr. Phan. **8**: 1–669. 1893), Lauterbach (Bot. Jahrb. **58**: 1–49. *fig. 1–10.* 1922), and Engler (in Engl. & Prantl, Nat. Pfl. ed. 2. **21**: 154–237. *fig. 68–107.* 1925). In the present paper, only the new or otherwise noteworthy species of recent collections are discussed; the order of genera and sections proposed by Engler is followed. My work has been facilitated by the examination of specimens in the following herbaria: Arnold Arboretum (A), New York Botanical Garden (NY), Yale School of Forestry (Y); the place of deposit is shown by the parenthetical letters, in the absence of which the specimen is to be found only in the herbarium of the Arnold Arboretum.

Hypericum L.

Hypericum (§ *Brathys*) **habbemense** sp. nov.

Frutex glaber gracilis ramosus ad 2 m. altus, ramulis gracilibus subteretibus fuscis vel purpurascentibus, novellis leviter complanatis vel obscure quadrangulatis; foliis oppositis, laminis sessilibus subamplexicaulibus papyraceis ovato-ellipticis, (9–)12–23 mm. longis, (4–)7–17 mm. latis, basi rotundatis, apice rotundatis vel obtusis, margine integris vel obscure undulatis, copiose glandulis utrinque paullo prominulis pellucido-punctatis, siccitate fusco-olivaceis vel subtus pallidioribus, 7–11-nervatis, nervis adscendentibus utrinque prominulis vel supra subplanis rete venularum inconspicuo obscure conjunctis; floribus nunc terminalibus et solitariis nunc in cymas plus minusve foliatas aggregatis sub anthesi 23–25 mm. diametro; pedicellis gracilibus ad 15 mm. longis apicem versus gradatim incrassatis; sepalis 5 persistentibus papyraceis lanceolato-ellipticis, 4–5 mm. longis, 1.5–2.2 mm. latis, longitudinaliter pellucido-glanduloso-lineolatis, apice obtusis, marginem versus parce pellucido-punctatis, margine interdum nigro-glanduloso-callosis; petalis 5 patentibus membranaceis obovato-ellipticis, 11–13 mm. longis, 6–8 mm.

*(Botanical Results of the Richard Archbold Expeditions) See Jour. Arnold Arb. **22**: 60–80. 1941; op. cit. 231–252.

latis, flabellatim 12–15-nervatis (nervis saepe furcatis), basi conspicue angustatis, apice rotundatis, margine integris et saepe parce glandulosis; staminibus 25–30 liberis, filamentis gracilibus 5–7 mm. longis, antheris ellipsoideis circiter 0.6 mm. longis; ovario ovoideo-ellipsoideo sub anthesi circiter 3.5 mm. longo et 2.5 mm. lato uniloculari, basi rotundato, placentis 3–5 parietalibus circiter 0.3 mm. latis, stylis 3–5 (raro 6) gracilibus 2–2.5 mm. longis, stigmatibus subtruncatis; capsulis stylis exceptis circiter 6 mm. longis polyspermis, apice stylis persistentibus coronatis, 3(–5)-valvis, seminibus complanatis ellipticis utrinque rotundatis 0.3–0.4 mm. longis.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2600–2650 m., *Brass 10865* (TYPE), Oct. 1938 (slender erect shrub up to 2 m. high, plentiful on open landslips in forest), *Brass 10979* (sparsely branched shrub 0.5–2 m. high, plentiful on open landslips in forest of lower slopes; flowers yellow, showy); Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11361* (slender shrub about 1 m. high, plentiful on open grassy banks of river; flowers yellow); southern slopes of Grand Valley (Lake Habbema region), alt. 1800–2000 m., *Brass* (coll. *Teerink*) *9261* (flowers yellow).

Hypericum habbemense is very distinct among species of the region, characterized by its fairly tall shrubby habit, its comparatively large, rounded, and conspicuously pellucid-punctate leaf-blades, its very large flowers, numerous stamens, and the variability in the number of its styles and placentas. While the styles appear to be most often three in number, four and five are common, and six are occasionally seen, but in this latter case I have not observed more than five placentas.

I have not seen material of *H. Hellwigii* Lauterb., but according to the description, *H. habbemense* is probably allied, differing in the characters mentioned above. *Hypericum papuanum* Ridley is described as an herb with smaller leaves and flowers than the new species, but nevertheless it seems possible that Ridley's species was based on a depauperate specimen and is actually the same as *H. habbemense*. As the description of *H. papuanum* is entirely inadequate, I venture to describe our plant as new, but a comparison of the types should eventually be made.

CALOPHYLLUM L.

Calophyllum (§ *Apoterium*) **procerum** sp. nov.

Arbor grandis ubique praeter partes novellas et bracteas inflorescentiarum ferrugineo- vel cinereo-puberulas vel tomentellas glabra, ramulis novellis angulatis mox teretibus et cinereis; petiolis 7–13 mm. longis

canaliculatis superne complanatis; laminis coriaceis oblongo-ellipticis, 4–7 cm. longis, 2–4 cm. latis, basi acutis et in petiolum decurrentibus, apice rotundatis vel obtusis, margine paullo incrassatis, costa valida supra conspicue canaliculata subtus prominente, nervis lateralibus numerosissimis (24–32 per centimetrum) patentibus utrinque leviter prominulis; inflorescentiis juvenilibus (solis visis) compactis minutis in ramulis inter folia orientibus vel interdum axillaribus; bracteis basi inflorescentiae 4 submembranaceis vel papyraceis elliptico-oblongis, 2.5–3 mm. longis, circiter 1.5 mm. latis, apice rotundatis, extus minute tomentellis; floribus 4 vel 5 per inflorescentiam pseudofasciculatis (minute racemosis, rhachi brevissima) bracteolis minutis glabris subtentis; sepalis 4, 2 exterioribus papyraceis suborbicularibus concavis in specimine nostro immaturis circiter 1 mm. longis et latis, 2 interioribus similibus sed submembranaceis; petalis ut videtur nullis; staminibus numerosis (80–100), filamentis immaturis brevissimis, antheris oblongis obtusis; ovario minuto glabro.

British New Guinea: Western Division, Lake Daviumbu, Middle Fly River, *Brass 7589* (type), Aug. 1936 (large tree with rounded leafy crown, forming, with a few other species, a scattered super-canopy layer in rain-forest; trunk cylindric, the bark gray, hard, deeply fissured, about 3 cm. thick on old trees; sap yellowish; the natives use this tree for their larger dugout canoes).

Although the inflorescences of the cited specimen are immature, it is apparent that even at maturity they would be unusually small, compact, and few-flowered. The position of the inflorescences, which are usually scattered along the branchlets rather than axillary, is also remarkable. *Calophyllum procerum* is a relative of *C. Versteegii* Lauterb., from which it differs in its longer petioles as well as in the size and position of the inflorescences as above mentioned.

Calophyllum (§ *Apoterium*) **Warburgii** Engl. in Engl. & Prantl, Nat. Pfl. III. **6**: 222. 1893; Lauterb. Nova Guin. Bot. **8**: 843. 1912; Lauterb. Bot. Jahrb. **58**: 13. 1922.

Calophyllum lanceolatum Warb. Bot. Jahrb. **13**: 381. 1891; non Bl. (1825), non Teijsm. & Binn. (1855).

British New Guinea: Western Division, Lake Daviumbu, Middle Fly River, *Brass 7698* (common tree in rain-forest canopy, the bark hard, suberose, fissured, with yellow latex; flowers white), *Brass 7724* (shapely tree 8–10 m. high, common in second growth rain-forest on old garden sites, the bark rusty brown, slightly flaky and with scattered very large lenticels; sap yellow, viscid; flowers white, fragrant), *Brass*

7745 (common tree of rain-forest canopy layer, the dark brown, thick, lenticellate, marked with shallow longitudinal fissures; sap cream-colored; flowers white, the filaments very slender), *Brass 7748* (better flowering material of *7745*).

The species has previously been reported only from the Key Islands and southern Netherlands New Guinea. Among the cited specimens, *7698* is an excellent match with *Warburg 20048* (type coll.); the other specimens have a tendency toward slightly broader leaves, more ample inflorescences, and larger sepals, but these characters hardly seem of nomenclatural value.

Also of this relationship is *Brass 7385* (BRITISH NEW GUINEA: Palmer River, 2 miles below junction with Black River, alt. 100 m.; canopy tree, common on the lower ridges). This specimen, in fruit, has leaves similar to those of the type collection of *C. Warburgii* but with the lateral nerves slightly more spaced. The fruiting inflorescences are racemose, up to 6.5 cm. long, and the apparently mature fruits are subglobose and about 14 mm. in diameter. Additional collections are desirable in order to ascertain the range of variation of *C. Warburgii*.

Calophyllum (§ *Apoterium*) **trachycaule** Lauterb. Bot. Jahrb. **58**: 13. *fig. 3*. 1922.

BRITISH NEW GUINEA: Central Division, Kubuna, alt. 100 m., *Brass 5654* (A, NY) (densely foliaged symmetrical tree 10 m. high, in rain-forest on low ridges, the bark pale brown, somewhat scaly; fruit dull blue).

The cited specimen agrees very well with the description and illustration of *C. trachycaule*, previously known from Northeastern New Guinea. Our specimen has the leaf-blades slightly larger (to 15 cm. long and 5 cm. broad) than those described and the fruits also somewhat larger (to 25 mm. long and 22 mm. broad), but these differences appear of little consequence.

Calophyllum (§ *Inophyllum?*) **solomonense** sp. nov.

Arbor grandis, ramulis juventute leviter angulatis (et gemmis) ferrugineo-puberulis vel -strigillosis mox subteretibus et fusco-cinereis; petiolis decidue puberulis rugosis crassis 15–23 mm. longis; laminis coriaceis subnitidis elliptico-oblongis, 11–23 cm. longis, 5.5–10 cm. latis, basi obtusis vel acutis et in petiolum decurrentibus, apice ut videtur obtusis vel rotundatis, margine incrassatis et leviter recurvatis, supra glabris, subtus praeter costam decidue ferrugineo-tomentellam glabris, costa valida supra valde elevata et inferne canaliculata subtus prominente et carinata, nervis lateralibus numerosis (18–26 per centimetrum) patenti-

bus leviter curvatis utrinque paullo prominulis; inflorescentiis sub fructu axillaribus racemosis (vel ut videtur interdum pseudofasciculatis) fructibus inclusis ad 4 cm. longis, pedunculo brevi et rhachi ad 12 mm. longis cum pedicellis 14–17 mm. longis rugosis et glabris, fructibus 1–3 per inflorescentiam ovoideo-subglobosis maturitate ad 22 mm. diametro, apice obtusis et stylo saepe coronatis, pericarpio 1.5–3 mm. crasso extra levi vel demum rugoso.

Solomon Islands: Guadalcanal: Ma-massa, Konga, alt. 500 m., *Kajewski 2469* (type), Feb. 8, 1931 (large tree up to 25 m. high, common in rain-forest, sometimes found on creek-banks and overhanging streams, the bark furrowed; native name: *coi-low;* an excellent timber-tree). Ysabel: Tataba, alt. 50 m., *Brass 3447* (common tree on rain-forest ridges, attaining large size, the bark rough, brown, scaly, the wood brown, tough; sap yellow, very viscid; branchlets, petioles, midribs, and leaf-margins brown; fruits mottled-green).

Calophyllum solomonense cannot definitely be referred to a section in the absence of flowers, but it bears a close resemblance to *C. inophyllum* L. in foliage, differing obviously in its greatly contracted inflorescences. In the Brass specimen the fruits appear to be solitary in the leaf-axils; in the type this is rarely the case, the fruits being arranged on very short racemes. The fruits of the Brass specimen are apparently essentially mature, in which condition they are much smaller than those of *C. inophyllum*. *Calophyllum vitiense* Turrill and *C. samoense* Christophersen are also of the relationship of *C. solomonense,* but both have slightly narrower leaf-blades, more ample inflorescences, and probably larger fruits. To the best of my knowledge, only the ubiquitous seacoast *C. inophyllum* has thus far been reported in the genus from the Solomons.

Calophyllum (§ *Inophyllum*) **vitiense** Turrill, Jour. Linn. Soc. Bot. **43:** 17. 1915.

Solomon Islands: Bougainville: Koniguru, Buin, alt. 850 m., *Kajewski 2020* (tree to 35 m. high, common in rain-forest; fruit yellow when ripe, to 38 mm. long and 25 mm. broad; native name: *pugiaro;* a good timber-tree). Guadalcanal: Ma-massa, Konga, alt. 400 m., *Kajewski 2463* (tree to 40 m. high, common in rain-forest, with medium-sized flanges and a rough furrowed bark; fruit black when ripe, to 30 mm. long and 22 mm. broad; tree furnishing an exceptionally fine cabinet wood); Uulolo, Tutuve Mt., alt. 1200 m., *Kajewski 2657* (tree to 30 m. high, common in rain-forest, the bark rough, furrowed; fruit purple when ripe, to 26 mm. long and 22 mm. broad; tree furnishing a fine cabinet wood).

The cited specimens are all in fruit, in which condition they agree in every respect with *Seemann 47* (cotype coll.) and several other Fijian specimens of *C. vitiense*. If my determination is correct, the species is to be anticipated in the New Hebrides. From Kajewski's notes, it seems that the tree is fairly common at middle elevation in the Solomons and is conspicuous by its great size.

Calophyllum (§ *Inophyllum*) **papuanum** Lauterb. Bot. Jahrb. **58**: 9. 1922.

NETHERLANDS NEW GUINEA: 4–6 km. southwest of Bernhard Camp, Idenburg River, alt. 850–1200 m., *Brass & Versteegh 13124* (occasional tree of primary forest in flood-plain, 23 m. high, the trunk 30 cm. diam., the crown small; bark 4 mm. thick, brownish black, with some dark yellow sap; sap-wood brown; heart-wood reddish brown; fruits green), *Brass & Versteegh 12518* (frequent tree of primary forest on the slope of a ridge, 34 m. high, the trunk 45 cm. diam., the crown fairly small; bark 10 mm. thick, dark brown, with yellow resin; wood red-brown; fruits green), *Brass 12786* (canopy tree in rain-forest, 25 m. high, the trunk 35 cm. diam.; lower surfaces of leaves brown-pubescent). NORTHEASTERN NEW GUINEA: Morobe District, Sattelberg, alt. 750 m. *Clemens 2278* (tree about 15 m. tall, on forest hill; fruits green); Yunzaing, alt. 1400 m., *Clemens 3656* (tree 30 m. high, in high forest, the trunk about 1 m. diam.; fruit green); Ogeramnang, alt. 1850 m., *Clemens 5389*.

Although the cited specimens bear fruit and leaves only, they can be referred to *C. papuanum* with some confidence; they agree with the description in all respects, including the persistently tomentellous or conspicuously puberulent aspect of the distal branchlets and the lower surface of the costa. Our specimens occasionally have the leaf-blades up to 10 cm. long and 5 cm. broad, slightly larger than those described by Lauterbach. The leaf-blades are often deciduously farinose-puberulent beneath. A description of the fruits, based on the cited material, follows:

Fruiting inflorescences compact, hardly exceeding 4 cm. in length (including fruits), the peduncles and pedicels stout, farinose-puberulent, the pedicels (above ultimate articulations) 5–8 mm. long; fruits usually reduced to 1 per inflorescence, glabrous, subglobose, at maturity about 2.5 cm. in diameter, the pericarp 4–8 mm. thick, smooth, the mesocarp spongy; seed ovoid.

Calophyllum (§ *Inophyllum*) **pauciflorum** sp. nov.

Arbor grandis ubique praeter partes novellas evanescenter ferrugineo-puberulas glabra, ramulis gracilibus novellis quadrangularibus demum teretibus et cinereis; petiolis rugulosis canaliculatis 3–10 mm. longis;

laminis coriaceis rhomboideo-ellipticis vel -obovatis, 3–7.5 cm. longis, 1.5–3.5 cm. latis, basi acutis, apice obtusis vel rotundatis, margine incrassatis et saepe recurvatis, subtus minute sed copiose glandulosopunctulatis, costa supra elevata et basim versus leviter canaliculata subtus prominente carinata, nervis lateralibus numerosissimis (18–25 per centimetrum) obliquis supra subimmersis subtus prominulis; inflorescentiis apices ramulorum versus axillaribus racemosis vel reductis et simplicioribus 1–3-floris, sub anthesi 1–1.5 cm. longis, pedunculo brevi et pedicellis (3–5 mm. longis) incrassatis, bracteis mox caducis; floribus sub anthesi 7–10 mm. diametro; sepalis 4, 2 exterioribus papyraceis late suborbicularibus, circiter 4 mm. longis et 4.5–5 mm. latis, glabris vel interdum extus inconspicue puberulis, 2 interioribus ut petalis similibus; petalis 4 submembranaceis obovato-suborbicularibus, 6–7.5 mm. longis et latis, arcte nervatis, margine scariosis et puberulenti-ciliolatis; staminibus numerosissimis (circiter 100), filamentis gracillimis filiformibus ad 6 mm. longis, antheris oblongis circiter 2 mm. longis apice mucronulatis; ovario glabro ovoideo sub anthesi circiter 2 mm. longo, stylo crasso ovarium aequante, stigmate peltato circiter 2 mm. diametro margine crenulato obscure trifido; inflorescentiis sub fructu brevibus (fructibus inclusis ad 3 cm. longis), pedunculo pedicellisque paullo incrassatis, fructibus plerumque solitariis subglobosis maturitate (?) ad 17 mm. diametro, apice stylo subpersistente coronatis, pericarpio 2–3 mm. crasso extus levi.

Northeastern New Guinea: Morobe District, Yunzaing, alt. 1250–1550 m., *Clemens 2378* (type), Apr. 21, 1936 (large tree, in Mt. Aloki forest; flowers white; anthers golden), *Clemens 3849;* Ogeramnang, alt. 1700 m., *Clemens 4955*. The type bears flowers, *3849* fruits, and *4955* flower-buds.

Calophyllum pauciflorum appears to be a close relative of *C. papuanum* Lauterb., from which it differs in its essentially glabrous habit, its somewhat rhomboid (rather than lanceolate-elliptic) leaf-blades which are smaller on the average, its more compact inflorescences, its much smaller flowers, its glabrous or puberulent (rather than furfuraceous) outer sepals, its much longer anthers with conspicuously elongate filaments, and its glabrous (rather than tomentose) ovary.

Calophyllum (§ *Inophyllum*) **congestiflorum** sp. nov.

Arbor 18–25 m. alta ubique sub anthesi glabra, ramulis juventute quadrangularibus mox teretibus et cinereis; petiolis rugulosis canaliculatis 2–5 mm. longis; laminis coriaceis oblongo- vel obovato-ellipticis, 2.5–5 cm. longis, 1.3–3 cm. latis, basi obtusis, apice rotundatis vel in-

terdum leviter emarginatis, margine paullo incrassatis, subtus inconspicue sed copiose glanduloso-punctulatis, costa supra canaliculata interdum paullo elevata subtus prominente carinata, nervis laterālibus numerosissimis (20–30 per centimetrum) patentibus supra subimmersis subtus leviter prominulis vel subplanis; inflorescentiis apices ramulorum versus axillaribus congestis breviter racemosis 1–3-floris, sub anthesi 7–10 mm. longis, pedunculo pedicellisque brevissimis paullo incrassatis, bracteis mox caducis; floribus sub anthesi 6–9 mm. diametro; sepalis 4, 2 exterioribus papyraceis late suborbicularibus, circiter 3 mm. longis, 3.5–4 mm. latis, glabris, margine puberulenti-ciliolatis, 2 interioribus ut petalis similibus; petalis 4 mox caducis submembranaceis late obovatis, 4.5–5.5 mm. longis et latis, arcte nervatis, margine puberulenti-ciliolatis; staminibus numerosis (30–50), filamentis filiformibus 1.5–3 mm. longis, antheris oblongis 0.7–1 mm. longis apice obtusis; ovario glabro subgloboso sub anthesi circiter 2 mm. diametro, stylo brevi crasso, stigmate juvenili non viso sub anthesi ut videtur subpeltato; inflorescentiis sub fructu brevibus, fructibus plerumque solitariis subglobosis immaturis ad 12 mm. diametro, apice stylo coronatis, pericarpio tenui levi vel siccitate ruguloso.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1800 m., *Brass & Versteegh 11902* (TYPE), Jan. 10, 1939 (tree 18 m. high, frequent in mossy forest on crests of ridges, the trunk 40 cm. diam., the crown small; bark 8 mm. thick, dark brown, fairly smooth, with light yellow resin; sap-wood rose; heart-wood red; flowers white), *Brass 12122* (tree up to about 25 m. high, a mossy forest co-dominant, the trunk about 80 cm. diam.; sap somewhat milky; wood pale and soft, an excellent fuel when green; flowers white); 8 km. southwest of Bernhard Camp, alt. 1600 m., *Brass 12721* (tree 20 m. high, in mossy forest, the trunk 25 cm. diam.; fruit immature). BRITISH NEW GUINEA: Western Division, Palmer River, 2 miles below junction with Black River, *? Brass 7099* (canopy tree with spurred trunk, plentiful in ridge-forests, the bark thick, flaky, yellowish, suberose; crown compact, the leaves rigid; immature fruit about 1 cm. diam.).

Calophyllum congestiflorum appears to represent a continuation of the trend toward reduced inflorescences and smaller flowers, seen in the preceding new species (*C. pauciflorum*), both of these species being related to *C. papuanum* Lauterb. *Calophyllum congestiflorum* differs from *C. pauciflorum* not only in its more compact inflorescences and smaller flowers, but also in its much shorter anthers and filaments. This latter character does not necessarily follow the size of the flowers, since *C. papuanum*, with large flowers, has small anthers. The new

species differs from *C. papuanum* in its glabrous habit and small leaves, as well as in obvious floral characters.

The type and *12122* bear flowers, *12721* immature fruits. The specimen from the Palmer River is questionably referred to this species. It bears immature fruits and has foliage very similar to that of the other cited specimens, but with a trace of furfuraceous puberulence on the lower surface of the costa and with even more obscure glandular punctation. It may represent an undescribed species; should it prove to belong to *C. congestiflorum,* the species will have an unusually broad altitudinal range.

Both *C. congestiflorum* and *C. pauciflorum* bear a marked resemblance to the Fijian *C. cerasiferum* Vesque (known only in fruiting condition), a species with slightly larger (on the average) leaf-blades with closer lateral nerves and less obvious glandular punctations on the lower surfaces.

Calophyllum (§ *Inophyllum*) **costatum** F. M. Bailey, Queensl. Fl. 104. 1899; Compr. Cat. Queensl. Pl. *fig. 40.* 1913.

British New Guinea: Western Division, Gaima, Lower Fly River (east bank), *Brass 8337* (rain-forest canopy tree attaining 25–30 m. in height, the bark thick, scaly, secreting a green glutinous sap; outer wood ripple-marked; flowers white).

Originally based on a fruiting specimen collected in Queensland by Bailey, *C. costatum* has not previously been reported from New Guinea. Having compared the Brass specimen with the cited plate and a sterile specimen collected in North Queensland by C. T. White, I feel reasonably sure of the determination. However, it is conceivable that collection of flowering specimens in Queensland will establish the specific distinctness of our plant, in which case it probably represents a new species; it is none of those treated by Lauterbach (loc. cit. 8–14), being only distantly related to *C. papuanum* Lauterb. The inflorescences of the Brass specimen are here described:

Inflorescences axillary toward apices of branchlets, racemose, usually 1–3-flowered, 1–2 cm. long at anthesis, the peduncle short, deciduously puberulent, the pedicels slender, 3–5 mm. long, the bracts small, caducous; flowers about 10 mm. in diameter at anthesis; sepals 4, the 2 outer ones papyraceous, suborbicular, 3–4 mm. in diameter, glabrous, with faintly puberulent-ciliolate margins, the 2 inner ones similar to petals; petals 4, membranous, obovate-elliptic, at anthesis 5–6 mm. long and 3–4.5 mm. broad, glabrous, obscurely ciliolate at margins, finely nerved, often reflexed at margins; stamens 50–60, the filaments filiform, 3–4 mm. long at anthesis, the anthers oblong, about 2.5 mm.

long, mucronulate at apex; ovary glabrous, ellipsoid, 1.5–2 mm. long at anthesis, the style equalling the ovary, the stigma peltate, 1.5–2 mm. in diameter, irregularly bifid, crenulate at margins.

Calophyllum (§ *Inophyllum?*) **Brassii** sp. nov.

Arbor ad 20 m. alta sub fructu ubique praeter ramulos inflorescentiarum decidue ferrugineo- vel cinereo-puberulos glabra, ramulis robustis (apicem versus 4–6 mm. diametro) leviter angulatis et saepe striatis demum subteretibus et cinereis, interdum conspicue lenticellatis; petiolis rugosis crassis (3–5 mm. diametro) 2–4 mm. longis; laminis crasse coriaceis subnitidis oblongis, 12–17 cm. longis, 5–6 cm. latis, basi rotundatis, apice ut videtur rotundatis vel obtusis, margine incrassatis et conspicue sed anguste recurvatis, costa valida supra leviter elevata (inferne canaliculata superne carinata) subtus valde prominente, nervis lateralibus numerosis (16–28 per centimetrum) patentibus subrectis utrinque inconspicue prominulis; inflorescentiis sub fructu apices ramulorum versus axillaribus paniculatis fructibus inclusis ad 6.5 cm. longis et 8 cm. latis, pedunculo brevissimo, ramulis paucis et rhachi rugosis angulatis robustis (2–3 mm. diametro), pedicellis 8–24 mm. longis crassis superne leviter incrassatis; fructibus pluribus (5–8 vel ultra) per inflorescentiam ovoideo-subglobosis, ut videtur maturitate et siccitate ad 13 mm. diametro, apice obtusis et stylo brevi saepe coronatis, pericarpio siccitate circiter 2 mm. crasso extra demum rugoso, epicarpio tenui, mesocarpio suberoso.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass & Versteegh 13122* (TYPE), March 7, 1939 (tree 20 m. high, frequent in primary rain-forest on the flat plain, the trunk 55 cm. in diameter, the crown not wide-spreading; bark 14 mm. thick, brown, scaly, with pale yellow sap, the sap-wood brown, the heart-wood dark brown; fruits green).

Calophyllum Brassii is a species characterized by its unusually thick oblong leaf-blades with very short petioles. Known only from the cited fruiting specimen, the species cannot be accurately placed within the genus, but its comparatively short paniculate inflorescences suggest *C. Kiong* Lauterb. & K. Schum., perhaps its closest ally. *Calophyllum Brassii* differs from *C. Kiong* in having short petioles, leaf-blades narrower and rounded rather than cuneate or acute at base, and lateral nerves less obvious and less crowded.

Calophyllum savannarum sp. nov.

Arbor 10–12 m. alta sub fructu ubique glabra, ramulis gracilibus juventute leviter complanatis vel angulatis mox subteretibus et fusco-

cinereis ad nodos paullo incrassatis; petiolis leviter canaliculatis vel complanatis 9–17 mm. longis; laminis coriaceis siccitate fusco-olivaceis anguste elliptico-oblongis, 8–13 cm. longis, 3.5–5.5 cm. latis, basi acutis et in petiolum decurrentibus, apice gradatim acuminatis (acumine ad 1 cm. longo obtuso), margine leviter incrassatis et paullo recurvatis, costa supra elevata et basim versus canaliculata subtus prominente et saepe carinata, nervis lateralibus valde adscendentibus subrectis 10–16 per centimetrum utrinque valde prominulis; inflorescentiis sub fructu axillaribus vel subterminalibus racemosis fructibus inclusis 3–9 cm. longis, rhachi gracili (1–2 mm. diametro), pedicellis 6–15 mm. longis superne incrassatis, fructibus ut videtur 3–7 per inflorescentiam vel interdum paucioribus ellipsoideis maturitate ad 22 mm. longis et 15 mm. latis, apice rotundatis et stylo saepe apiculatis, basi rotundatis, epicarpio tenui levi glaucescente, mesocarpio suberoso.

NETHERLANDS NEW GUINEA: Vicinity of Hollandia, alt. 20–100 m., *Brass 8888* (TYPE), June 29, 1938 (tree 10–12 m. high, one of the principal species of forest clumps on secondary savannas; fruits blue).

Calophyllum savannarum, although represented by a fruiting specimen only, is quite distinct among species of *Calophyllum* in the region in its conspicuous lateral nerves, which ascend at an angle approaching 45°. Among Papuan species, it seems most suggestive of *C. Sil* Lauterb., differing in its venation, its leaf-shape, its longer fruiting pedicels, and its somewhat larger fruits. The true relationship of the new species is hardly to be ascertained until flowers are available.

Calophyllum Kajewskii sp. nov.

Arbor grandis sub fructu ubique glabra, ramulis crassis (apices versus 4–6 mm. diametro) purpurascentibus rugosis demum fuscis et lenticellatis; petiolis crassis (circiter 3 mm. diametro) rugosis 15–20 mm. longis leviter canaliculatis; laminis coriaceis subnitidis oblongo- vel obovato-ellipticis, 14–17 cm. longis, 6–9 cm. latis, basi acutis et in petiolum decurrentibus, apice rotundatis, margine conspicue incrassatis et saepe leviter recurvatis, costa valida supra valde elevata (inferne canaliculata superne carinata) subtus prominente et carinata, nervis lateralibus numerosis (14–20 per centimetrum) erecto-patentibus subrectis utrinque prominulis; inflorescentiis non visis; fructibus magnis subglobosis 5–6 cm. diametro, longitudinaliter multicostatis (costis non conspicuis sed facile distinguitur), basi et apice rotundatis, pericarpio lignoso 10–15 mm. crasso.

SOLOMON ISLANDS: Bougainville: Koniguru, Buin, alt. 800 m., *Kajewski 2024* (TYPE), Aug. 6, 1930 (large rain-forest giant,

common, the bark slightly furrowed; fruit green, more or less globular, with slightly raised ridges; native name: *sikoraku*); Siwai, *Waterhouse 201* (NY) (large tree with orange-like fruit; native names: *huwau, manuba, qalukoko, bunkbuni*).

Although it is represented only by foliage and a single detached fruit accompanying the type, in which condition it cannot be referred to a section, the cited specimens are so distinct that I venture to describe them as new. No *Calophyllum* thus far known from the region, as far as I can ascertain, has such an extremely large and woody fruit. The foliage of *C. Kajewskii* closely resembles that of the lowland *C. inophyllum* L., which, of course, has a very different fruit. The only available sheet of *Waterhouse 201* is sterile, but its foliage and the note implying the size of the fruit strongly suggest *C. Kajewskii*.

GARCINIA L.

Garcinia (§ *Xanthochymus*) **Warburgiana** nom. nov.

Xanthochymus novo-guineensis Warb. Bot. Jahrb. **13**: 381. 1891.
Garcinia novo-guineensis Warb. ex Lauterb. Nova Guinea Bot. **8**: 309. 1910; Bot. Jahrb. **58**: 19. 1922; non Vesque (1893).

The necessity for applying a new name to this species arises from the fact that Warburg's parenthetical mention of *Garcinia* does not alter his acceptance of *Xanthochymus* as the genus of his new species. *Garcinia novo-guineensis* Vesque was referred by Lauterbach to *G. Edelfeldtii* (Lauterb. Bot. Jahrb. **58**: 21. 1922), which is therefore an unnecessary binomial. Although known from several specimens from other sections of New Guinea, *G. Warburgiana* has not previously been reported from British New Guinea, where it is represented by the following collections:

BRITISH NEW GUINEA: Koitaki, alt. 450 m., *Carr 12727* (NY) (tree 25 m. high; fruit green), *Carr 12735* (NY) (tree 12 m. high; buds green); Western Division, Mabaduan, *Brass 6489* (common in monsoon-forest substage; excurrent richly branched tree attaining 20 m., exuding a cream colored latex when cut; leaf-blades stiff, the largest ones about 30 cm. long, at ends of branchlets, the nerves deeply impressed above, prominent beneath; fruit pale yellow, about 3.5 cm. diam.); Lower Fly River, east bank opposite Sturt Island, *Brass 7976* (sub-canopy tree to 25 m. high, occasional on ridges in rain-forest, the bark hard, slightly scaly, the latex white; flowers greenish white).

Our specimens have the leaf-blades considerably larger than those previously described; according to Brass' notes these attain a size of

30 cm. long and presumably about 17 cm. broad. The staminate flowers of *Brass 7976* are also unusually large, with petals up to 9 mm. long and broad and phalanges up to 7 mm. long.

Garcinia (§ *Cambogia*) **angustifolia** sp. nov.

Arbor gracilis glabra ad 5 m. alta, ramulis gracilibus (apicem versus 1–2 mm. crassis) cinereis juventute inconspicue quadrangulatis demum teretibus; petiolis gracilibus (0.5–1 mm. diametro) canaliculatis 6–10 mm. longis, basi foveola inconspicua praeditis; laminis membranaceis vel tenuiter papyraceis siccitate fusco-viridibus lanceolato-oblongis, 8–14 cm. longis, 2–3.5 cm. latis, basi subattenuatis et in petiolum decurrentibus, apice cuspidatis vel abrupte acuminatis (acumine 3–8 mm. longo obtuso), margine integris, costa supra paullo canaliculata et saepe inconspicue elevata subtus prominente, nervis lateralibus utrinsecus 15–20 (cum nervis debilioribus interdum interspersis) erecto-patentibus utrinque prominulis nervo marginali conjunctis, venulis inconspicuis; inflorescentiis in axillis foliorum saepe delapsorum pulvinatis, floribus ♂ paucis (juvenilibus 3–5 sed sub anthesi plerumque 1) sessilibus sub anthesi circiter 5 mm. longis et 4 mm. diametro, bracteis inconspicuis deltoideis suffultis; sepalis 4 subaequalibus anguste imbricatis papyraceis ovato-deltoideis, 1.5–2 mm. longis et latis, apice rotundatis, margine scariosis et integris vel minute erosulis; petalis 4 valvatis sub anthesi suberectis tenuiter carnosis obovato-lanceolatis, 3.5–4 mm. longis, 1–1.3 mm. latis, apice rotundatis, margine subintegris; staminibus 5 vel 6 liberis toro carnoso subtereti erecto 1–1.5 mm. longo insertis, antheris 1- vel 2-seriatis sessilibus oblongis, circiter 1 mm. longis et 0.5 mm. latis, apice truncatis vel minutissime papillosis, loculis 2 rimis elongatis lateralibus dehiscentibus; ovario nullo.

Netherlands New Guinea: Vicinity of Hollandia, alt. 100 m., *Brass 8990* (type), July 8, 1938 (tree 5 m. high, occasional in rain-forest undergrowth).

Garcinia angustifolia is characterized by its thin and narrow leaf-blades and the reduced number of its stamens. It is a close relative of *G. pachypetala* Lauterb., a montane species; although mature flowers of *G. pachypetala* have not been described, they have 8–10 stamens and are apparently larger than those of the new species.

Garcinia (§ *Cambogia*) **pachyantha** sp. nov.

Arbor parva glabra, ramulis crassis (apicem versus 2–4 mm. crassis) juventute paullo complanatis mox teretibus et cinereis; petiolis rugulosis leviter canaliculatis 10–22 mm. longis, basi foveola inconspicua praeditis; laminis papyraceis vel chartaceis elliptico-oblongis, 8–17 cm. longis, 3–6.5

cm. latis, basi subattenuatis et in petiolum decurrentibus, apice abrupte acuminatis (acumine 5–10 mm. longo obtuso), margine integris et anguste recurvatis, costa supra leviter canaliculata subtus prominente, nervis lateralibus utrinsecus 15–20 erecto-patentibus interdum furcatis cum aliis brevioribus interspersis utrinque prominulis nervo marginali conjunctis, venulis subimmersis; floribus ♂ paucis (plerumque sub anthesi singulis) ex pulvinis conspicuis axillaribus sessilibus, sub anthesi 14–16 mm. diametro, bracteis inconspicuis mox deciduis suffultis; sepalis 4 papyraceis vel submembranaceis anguste imbricatis late semiorbicularibus, 2.5–3.5 mm. longis, 4–5.5 mm. latis, apice rotundatis, margine integris et scariosis; petalis 4 anguste imbricatis carnosis oblongis, 7–8 mm. longis, 4–5 mm. latis, apice rotundatis, margine anguste scariosis et integris; staminibus 21–25 liberis toro applanato vel paullo convexo insertis, antheris sessilibus oblongis, 1.5–1.8 mm. longis, circiter 1 mm. latis, apice truncatis, connectivo crasso, loculis 2 rimis elongatis lateralibus dehiscentibus; ovario nullo; fructibus axillaribus sessilibus ut videtur subglobosis et ad 2.5 cm. diametro, basi sepalis persistentibus suffultis, apice stigmate sessili circiter 5 mm. diametro coronatis, seminibus plus minusve 10, pericarpio carnoso.

NORTHEASTERN NEW GUINEA: Morobe District, Sattelberg, alt. 1030 m., *Clemens 3080* (TYPE), May 12, 1936 (on forest hill above mission; flowers white); Yunzaing, alt. 1400 m., *Clemens 3597A* (tree, the trunk 13–15 cm. diam., along forest trail), *Clemens 4183* (small tree, the trunk about 13 cm. diam.; fruit green). Nos. *3080* and *3597A* bear ♂ flowers; no. *4183* is accompanied by a few badly dried fruits.

Garcinia pachyantha is related to *G. fruticosa* Lauterb., differing in its proportionately broader leaf-blades with more numerous lateral nerves, its longer petioles, its larger flowers, especially as regards the carnose petals, and its fewer stamens (21–25 rather than about 30).

Garcinia (§ *Cambogia*) **riparia** sp. nov.

Arbor glabra 5–15 m. alta, ramulis ut videtur elongatis subteretibus (apicem versus complanatis) juventute fuscis demum cinereis; petiolis circiter 2 mm. crassis leviter canaliculatis 15–22 mm. longis, basi foveola deltoidea inconspicua ornatis; laminis tenuiter papyraceis elliptico-oblongis, 12–20 cm. longis, 5.5–9 cm. latis, basi acutis vel gradatim attenuatis et in petiolum decurrentibus, apice cuspidatis vel acuminatis (acumine ad 15 mm. longo obtuso), margine integris et anguste recurvatis, costa supra paullo elevata et obscure striata vel canaliculata subtus prominente, nervis lateralibus utrinsecus 8–12 adscendentibus

vel erecto-patentibus utrinque conspicue elevatis marginem versus valde adscendentibus, rete venularum inconspicuo vel utrinque paullo prominulo; floribus ♂ paucis (juvenilibus ut videtur pluribus sed sub anthesi plerumque 1 vel 2) ex pulvinis conspicuis (ad 7 mm. diametro) in axillis foliorum delapsorum sessilibus, sub anthesi ad 15 mm. diametro, bracteis minutis suffultis; sepalis 4 papyraceis late ovato-semiorbicularibus, circiter 4 mm. longis, 4–5 mm. latis, apice rotundatis, margine scariosis et integris; petalis 4 in alabastro imbricatis sub anthesi crasse carnosis anguste obovato-oblongis, 7–8 mm. longis, 3–4 mm. latis, apice rotundatis, margine integris vel minute erosulis; androecio conspicuo, toro cylindrico crasse carnoso 1.5–2 mm. longo 1–1.3 mm. diametro apice incrassato et stamina 40–50 gerente, antheris subsessilibus confertis oblongis, 0.5–0.6 mm. longis, circiter 0.3 mm. latis, apice truncatis vel leviter emarginatis, loculis 2 rimis verticalibus lateralibus dehiscentibus; ovario nullo; fructibus axillaribus sessilibus subgloboso-obovoideis, maturitate ad 7 cm. longis et 5 cm. latis, basi sepalis persistentibus suffultis, apice rotundatis et stigmate sessili radiatim rugoso circiter 4 mm. diametro coronatis, extra conspicue 7–10-costatis, pericarpio siccitate coriaceo, seminibus 7–10 oblongis in pulpo nidulantibus.

British New Guinea: Western Division, Sturt Island, Lower Fly River, *Brass 8154* (type), Oct. 1936 (loosely branched undergrowth tree 5–6 m. high, plentiful in flood-plain rain-forest; flowers pale pink, with a fungus on petals); Lower Fly River, east bank opposite Sturt Island, *Brass 8025* (weak spreading tree 5–6 m. high, common in undergrowth in rain-forest on flood-plain; leaf-margins recurved; fruit green, broadly pyriform, almost sessile below the leaves); Lake Daviumbu, Middle Fly River, *Brass 7588* (tree 15 m. high, in rain-forest substage; fruit yellow-green, solitary, sessile on old wood). The type bears ♂ flowers, the other two specimens being in fruit.

Garcinia riparia is a very distinct species of § *Cambogia*, characterized by its thin leaf-blades with comparatively few and ascending lateral nerves, few-flowered inflorescences with large sessile flowers, and a conspicuous columnar androecium with numerous stamens. It appears to be closely related to *G. Ledermannii* Lauterb., from which it differs in its fewer lateral nerves, larger leaf-blades, smaller flowers, especially as regards the petals and androecium, and its larger and conspicuously costate fruits with more numerous seeds.

Garcinia (§ *Cambogia*) **solomonensis** sp. nov.

Arbor glabra ad 25 m. alta, ramulis apicem versus quadrangulatis demum teretibus et fusco-cinereis; petiolis rugulosis canaliculatis 8–12

(–20) mm. longis, basi foveola oblonga inconspicua ornatis; laminis papyraceis siccitate fusco-olivaceis elliptico-oblongis, 8–15 mm. longis, 3.5–6(–8) cm. latis, basi acutis vel attenuatis et in petiolum decurrentibus, apice cuspidatis vel acuminatis (acumine 3–10 mm. longo obtuso), margine integris et anguste revolutis, costa supra subplana vel leviter canaliculata subtus prominente, nervis lateralibus utrinsecus 8–12(–14) erecto-patentibus utrinque valde prominulis marginem versus arcuatis et nervo marginali conjunctis, rete venularum inconspicuo plerumque immerso; floribus ♂ paucis (sub anthesi plerumque solitariis) ex pulvinis interdum conspicuis in axillis foliorum mox delapsorum sessilibus, sub anthesi 5–7 mm. diametro, bracteis 4 imbricatis papyraceis reniformi-suborbicularibus ad 1.5 mm. longis suffultis; sepalis 4 tenuiter carnosis oblongo-suborbicularibus, 2–3.5 mm. longis et latis, apice rotundatis, margine integris; petalis 4 (in specimine nostro ut videtur immaturis) carnosis oblongis, 2–2.5 mm. longis, 1–1.5 mm. latis, apice rotundatis, margine integris; staminibus 40–45 congestis toro leviter convexo insertis, antheris subsessilibus liberis multiseriatis oblongis, circiter 0.35 mm. longis et 0.25 mm. latis, apice truncatis, basim versus paullo angustatis, connectivo leviter incrassato, loculis 2 rimis verticalibus lateralibus dehiscentibus; ovario nullo; fructibus axillaribus sessilibus subglobosis vel ellipsoideis, maturitate ut videtur ad 4 cm. diametro, basi sepalis persistentibus suffultis, apice rotundatis et stigmate sessili inconspicuo coronatis, extra inconspicue 7–10-costatis, pericarpio carnoso, seminibus 7–10 in pulpo nidulantibus.

SOLOMON ISLANDS: Bougainville: Siwai, *Waterhouse 186* (A, NY, TYPE, Y) Jan. 1933 (small tree about 5 m. high, the trunk about 35 cm. diam.; native name: *pinuhunuhunu*); Kugumaru, Buin, alt. 150 m., *Kajewski 1816* (medium-sized tree up to 20 m. high, common in rain-forest; bark with a yellow sap; fruit green, with yellow sap; native name: *na-boita*); Lake Luralu, Koniguru, Buin, alt. 1500 m. *?Kajewski 2063* (small tree, common among stunted vegetation in rain-forest; leaves purple-veined; fruit plum colored; native name: *sipego*); Kupei Gold Field, alt. 950 m., *?Kajewski 1673* (tree up to 25 m. high, common in rain-forest; fruit yellow-red when ripe). Guadalcanal: Ma-massa, Konga, alt. 500 m., *Kajewski 2484* (tree to 18 m. high, common in rain-forest; fruit apple-shaped, yellow-green when ripe, with pleasant fragrance and not abundant pulp).

Of the cited specimens, only the type collection is in flower; the others bear fruits, but only *Kajewski 2484* appears to have a ripe fruit. The two questioned Kajewski collections are dubiously included in this species; they occur at higher elevations than the others and have thicker

leaf-blades with more robust petioles; their fruits, although young, appear to be proportionately longer than those of *Kajewski 1816* and *2484,* of which the former especially is a good foliage match for the type.

Garcinia solomonensis is characterized by its sessile and usually solitary flowers with numerous stamens. Its relationship is probably with *G. Ledermannii* Lauterb. and *G. Assugu* Lauterb., but it differs from the first in such obvious characters as its fewer secondary nerves, small flowers, and inconspicuous androecium-torus, and from the second in its few flowers, small anthers, few secondary nerves, etc.

Garcinia (§ *Cambogia*) **macrantha** sp. nov.

Arbor parva glabra, ramulis crassis (apicem versus 5–7 mm. diametro) rugosis juventute quadrangulatis demum subteretibus; petiolis crassis (3–5 mm. diametro) rugosis leviter canaliculatis 15–30 mm. longis, basi foveola conspicua oblonga ad 10 mm. longa ornatis; laminis tenuiter coriaceis vel chartaceis amplis siccitate fusco-olivaceis elliptico-oblongis, 18–32 cm. longis, 8–14 cm. latis, basi obtusis vel rotundatis et in petiolum paullo decurrentibus, apice obtusis vel obtuse cuspidatis, margine integris vel undulatis et leviter recurvatis, costa supra paullo elevata et saepe striata vel canaliculata subtus valde prominente et saepe carinata, nervis lateralibus utrinsecus 25–35 (cum nervis brevioribus debilioribus copiose interspersis) erecto-patentibus subrectis utrinque prominulis nervo marginali distincto conjunctis, rete venularum inconspicuo plerumque immerso; floribus ♂ apice ramulorum fasciculatis ex pulvinis inconspicuis inter folia terminales orientibus 7–10 per inflorescentiam, sub anthesi 30–40 mm. diametro, bracteis paucis papyraceis oblongo-deltoideis acutis ad 10 mm. longis suffultis; pedicellis teretibus crassis (2–3 mm. diametro) ad 18 mm. longis apicem versus incrassatis; sepalis 4 imbricatis, 2 exterioribus tenuiter coriaceis valde concavis late ovato-oblongis, 10–13 mm. longis, circiter 15 mm. latis, apice rotundatis, margine anguste scariosis et integris, 2 interioribus petalis similibus; petalis 4 carnosis sub anthesi patentibus suborbiculari-oblongis, 16–19 mm. longis, 12–15 mm. latis, apice rotundatis, margine anguste scariosis et integris, longitudinaliter dense sed inconspicue et irregulariter glanduloso-lineolatis; androecio conspicuo, toro semigloboso carnoso sub anthesi 5–8 mm. alto et circiter 10 mm. diametro, staminibus numerosissimis (circiter 200) confertis torum tegentibus, filamentis carnosis subteretibus 0.2–0.7 mm. longis, antheris crasse carnosis oblongis, 1.3–2 mm. longis, 0.8–1.2 mm. latis, saepe conspicue falcatis, apice obtusis, loculis 2 rimis conspicuis elongatis introrsis dehiscentibus; gynaecii rudimento parvo carnoso apice tori

inserto circiter 1.5 mm. longo, stigmate peltato circiter 2 mm. diametro margine paullo undulato.

BRITISH NEW GUINEA: Western Division, Lower Fly River, east bank opposite Sturt Island, *Brass 8092* (TYPE), Oct. 1936 (sparse tree, in undergrowth on ridges in rain-forest; latex drying bluish white; leaf-venation dark beneath; flowers brownish pink).

Although there seems no doubt that *G. macrantha* belongs in § *Cambogia,* it is so distinct from other species of the region as to make comparison superfluous. It is characterized by its remarkably large and coarse leaves and flowers, terminal inflorescences, conspicuous pedicels, the great number of its stamens, and the presence of a gynaecium-rudiment on the summit of the conspicuous antheriferous torus.

Garcinia (§ *Cambogia*) **balimensis** sp. nov.

Arbor parva glabra, ramulis crassis (apicem versus 4–5 mm. diametro) rugosis subteretibus (vel distaliter leviter complanatis) cinereis; petiolis rugosis 2–3 mm. diametro 7–15 mm. longis, basi foveola conspicua elliptica margine incrassata instructis; laminis tenuiter coriaceis siccitate fuscis late ellipticis, 8–12.5 cm. longis, 5–8 cm. latis, basi late obtusis, apice rotundatis vel obtusis et saepe leviter emarginatis, costa supra leviter canaliculata subtus valde prominente, nervis lateralibus utrinsecus circiter 20 (cum nervis paullo debilioribus alternatis) patentibus utrinque valde prominulis nervo marginali conjunctis, venulis inconspicuis interdum paullo prominulis; floribus ♀ axillaribus sessilibus solitariis sub anthesi 17–20 mm. diametro, bracteis 4 late imbricatis papyraceis reniformibus circiter 2 mm. longis et 4.5 mm. latis rotundatis integris subtentis; sepalis 4 subaequalibus imbricatis submembranaceis late semiorbicularibus, 4–5 mm. longis, circiter 8 mm. latis, apice rotundatis, margine integris, dense glanduloso-lineolatis; petalis 4 anguste imbricatis crasse carnosis obovato-oblongis, circiter 10 mm. longis, 6–7 mm. latis, apice rotundatis, margine anguste scariosis et subintegris; staminodiis 16–18 uniseriatis circiter 3 mm. longis breviter stipitatis oblongis subacutis, loculis 2 longitudinalibus ut videtur rimis verticalibus dehiscentibus; ovario breviter cylindrico rugoso sub anthesi circiter 3 mm. diametro, loculis 8–12 uniovulatis, stigmate 3–4 mm. diametro conspicue papilloso margine irregulariter lobato; fructibus axillaribus sessilibus subglobosis vel paullo complanatis, ad 3.5 cm. diametro (maturis ?), basi sepalis persistentibus suffultis, apice stigmate radiatim rugoso coronatis, pericarpio siccitate valde rugoso, seminibus 8–12 in pulpo sparso nidulantibus.

NETHERLANDS NEW GUINEA: Balim River, alt. 2100 m., *Brass 11753* (TYPE), Dec. 1938 (small tree in secondary forest; flowers yellow; fruit green).

Garcinia balimensis, although represented only by a specimen with pistillate flowers, seems to belong to § *Cambogia* by virtue of its several-celled ovary, is oblong staminodes arranged in a single row, and its solitary sessile flowers. It is characterized by coriaceous and proportionately broad leaf-blades and large flowers. Although I cannot place it as a close ally of any described Papuasian species, *G. balimensis* seems amply distinguished from those described by the above-mentioned combination of characters.

Garcinia (§ *Discostigma*) **Warrenii** F. v. Muell. Vict. Naturalist **8:** 109. 1891; Vesque in DC. Monogr. Phan. **8:** 641. 1893; Lauterb. Bot. Jahrb. **58:** 24. *fig. 5.* 1922.

Garcinia Branderhorstii Lauterb. Nova Guin. Bot. **8:** 311. 1910.

BRITISH NEW GUINEA: Central Division, Biriatabu, alt. 460 m., *Brass 568* (shapely tree 15 m. high, the bark light brown, somewhat scaly, the wood pale brown, used by natives for building and for handles of weapons; fruit with bright yellow sticky latex; native name: *fareti*); Hewa, Vailala River, *Brass 1117* (small compact tree 15 m. high, with stiff branches, on clay ridges close to sago swamps; fruit brown, eaten by natives; native name: *ekobu*); Western Division, Lower Fly River, east bank opposite Sturt Island, *Brass 7996* (rain-forest substage tree, plentiful on ridges, the bark brown-black, somewhat scaly; flowers cream colored); Lake Daviumbu, Middle Fly River, *Brass 7471* (tree up to 14 m. high, abundant in lake-shore substage, the branches spreading, the bark gray-black, shallowly fissured; flowers cream colored, fragrant); Tarara, Wassi Kussa River, *Brass 8430* (tree 10 m. high, common in rain-forest on clay banks of river; fruit red, subglobose, 3–3.5 cm. diam.; latex yellow).

The cited specimens surely represent *G. Branderhorstii,* which Lauterbach refers without question to the Queensland species *G. Warrenii.* Previously this species has been known from southern Netherlands New Guinea as well as Queensland.

Garcinia (§ *Tetrachoristemon*) **Lauterbachiana** sp. nov.

Frutex glabra, ramulis gracilibus apicem versus 0.7–1 mm. crassis quadrangulatis demum subteretibus cinereis; petiolis gracilibus leviter canaliculatis 2–4 mm. longis, basi foveola inconspicua ornatis; laminis submembranaceis vel papyraceis siccitate viridi-olivaceis lanceolato-ellipticis, 2–4.5 cm. longis, 0.7–1.7 cm. latis, basi acutis vel obtusis,

apice obtusis vel obtuse et breviter acuminatis, margine integris et leviter recurvatis, costa utrinque leviter elevata vel supra subplana, nervis lateralibus utrinsecus 3–5 adscendentibus nonnunquam furcatis utrinque paullo prominulis nervo marginali indistincte conjunctis, rete venularum immerso; stipulis membranaceis saepe conspicuis ad 5 mm. longis caducis, floribus ♂ solitariis (vel paucis?) ex pulvinis inconspicuis subsessilibus (pedicellis circiter 1.5 mm. longis), alabastro ellipsoideo circiter 2.5 mm. longo et 2 mm. diametro; sepalis 4 membranaceis elliptico-oblongis, circiter 2 mm. longis et 1.5 mm. latis, apice rotundatis, margine minute erosulis, conspicue longitudinaliter venosis; petalis 4 obovato-oblongis, 2.5–3 mm. longis, circiter 1 mm. latis, inferne carnosis superne submembranaceis, apice rotundatis, margine apicem versus scariosis et subintegris; staminibus 4 in apice tori inconspicui erectis, filamentis carnosis brevibus (circiter 0.2 mm. longis) basi connatis, antheris obovoideo-oblongis, 1–1.2 mm. longis, apice truncatis et 0.5 mm. latis, basim versus angustatis, rimis lateralibus verticalibus dehiscentibus; ovario nullo.

NORTHEASTERN NEW GUINEA: Morobe District, Ogeramnang, alt. 1700 m., *Clemens 5441* (TYPE), Feb. 18, 1937; Yunzaing, alt. 1400 m., *Clemens 2975* (undershrub, on forested hills; buds orange), *Clemens 6470a;* Finisterre Gebirge, alt. 1300 m., *Schlechter 19105* (A, NY).

The cited specimens are sterile, with the exception of a single nearly mature flower on the type and a few buds on *Clemens 2975;* nevertheless the species is so readily recognized by its foliage that I have no doubt that the specimens are conspecific.

Garcinia Lauterbachiana shows a close affinity with *G. maluensis* Lauterb., the only previously known member of § *Tetrachoristemon,* which it resembles in its habit, stipules, leaf-texture, and floral structure. The new species differs from *G. maluensis* in its remarkably small leaf-blades, its truncate but not apically papillose anther-connectives, and its lack of a gynaecium-rudiment in the staminate flowers. Otherwise, especially in texture of sepals and petals, the staminate flowers of the two species are nearly identical.

Garcinia (§ *Tetrachoristemon*) **rhynchophylla** sp. nov.

Arbor gracilis 3–4 m. alta glabra, ramulis gracilibus apicem versus 1 mm. vel minus crassis quadrangulatis demum subteretibus cinereis striatis; petiolis gracilibus leviter canaliculatis, 4–5 mm. longis, basi foveola inconspicua praeditis; laminis submembranaceis siccitate viridibus anguste ovato-lanceolatis, 2.5–5 cm. longis, 0.7–1.3 cm. latis, basi acutis, apice caudato-acuminatis (acumine 7–15 mm. longo acuto incon-

spicue calloso), margine integris, costa supra leviter prominula et canaliculata subtus paullo elevata, nervis lateralibus utrinsecus 8–10 (cum aliis debilioribus interspersis) interdum furcatis patentibus utrinque minute prominulis marginem versus indistincte anastomosantibus, venulis intricate ramulosis utrinque minute prominulis vel subimmersis; stipulis linearibus 3–5 mm. longis mox caducis; fructuum pedicellis gracilibus ad 5 mm. longis; fructibus axillaribus subglobosis ad 2.3 cm. diametro (immaturis?), basi sepalis 4 imbricatis papyraceis semiorbicularibus ad 2 mm. longis et 3 mm. latis suffultis, apice rotundatis et stigmate sessili circiter 2 mm. diametro radiatim rugoso coronatis, extra ut videtur levibus, pericarpio tenui, seminibus paucis in pulpo sparso nidulantibus.

NETHERLANDS NEW GUINEA: 6 km. southwest of Bernhard Camp, Idenburg River, alt. 1200 m., *Brass 12867* (TYPE), Feb. 1939 (tree 3–4 m. high, frequent in rain-forest undergrowth; unripe fruit up to 2.3 cm. diam.).

Garcinia rhynchophylla, based on the above cited fruiting specimen, is almost certainly closely related to *G. Lauterbachiana* (above described), differing in its caudate-acuminate leaf-blades with more numerous and spreading lateral nerves, more obvious veinlets, and presumably pedicellate flowers (as indicated by the pedicels of the fruits).

Garcinia (§ *Hebradendron*) **subtilinervis** F. v. Muell. Descr. Notes Pap. Pl. **1:** 85. 1877; Vesque in DC. Monogr. Phan. **8:** 488. 1893; Lauterb. Nova Guin. Bot. **8:** 312. 1910; Lauterb. Bot. Jahrb. **58:** 38. 1922.

BRITISH NEW GUINEA: Koitaki, alt. 450 m., *Carr 12567* (NY), *12795* (NY); Kanosia, sea-level, *Carr 11299* (?) (NY), *11301* (?) (NY); Western Division, Palmer River, 2 miles below junction with Black River, alt. 100 m., *Brass 7310* (small slender tree 3 m. high, common in ridge-forest undergrowth; flowers cream colored), *Brass 7006* (forest substage tree 6–8 m. high, common on low ridges and river-flats; leaves coriaceous, with recurved margins; fruit green, sessile on old wood), *Brass 7077* (tree 8–10 m. tall, common constituent of ridge-forest substage; branches slender, always heavily mossed; fruit sessile below leaves, pale green); Lower Fly River, east bank opposite Sturt Island, *Brass 8061* (undergrowth tree 2–3 m. high, in rain-forest on ridges; branches drooping, horizontal; leaf-nerves obscure; fruit red, solitary, sessile).

The cited specimens agree very closely with the original description, although this is so brief that comparison with the type (*D'Albertis* from

the Fly River) is desirable. Nevertheless, I refer our collections to the species with some confidence; they bear a close superficial resemblance to the Indian *G. cowa* Roxb., a point emphasized by Mueller. Lauterbach cited a specimen of *G. subtilinervis* from southern Netherlands New Guinea and referred the species to § *Cambogia* with a question. If my identification is correct, however, the species belongs in § *Hebradendron*. Previous descriptions being incomplete, it seems advisable to redescribe the species on the basis of the above cited specimens:

Glabrous slender tree to 12 m. high, the branchlets slender, distally quadrangular, the older ones subterete and cinereous; petioles slender (usually less than 1 mm. in diameter), shallowly canaliculate, 4–10(–20) mm. long, inconspicuously foveolate at base; leaf-blades papyraceous or submembranaceous when dried, olivaceous, narrowly elliptic or obovate-elliptic, 7–12(–20) cm. long, 3–5(–7.5) cm. broad, obtuse to subattenuate at base, acuminate at apex (acumen 5–15 mm. long, obtuse), entire and narrowly recurved at margins, the costa slightly raised to shallowly impressed above, subprominent beneath, the lateral nerves usually 10–12 per side, arcuate-ascending, prominulous (usually inconspicuously so) on both sides, the veinlets few, inconspicuous, submersed; ♂ flowers few (apparently 2–5 per inflorescence, probably often solitary at anthesis), on inconspicuous axillary glomerules, 3–4 mm. in diameter at anthesis, subtended by minute bracts, pedicellate (pedicels very slender, 2–3 mm. long); sepals 4, membranous, subequal, elliptic-oblong, 1.5–2 mm. long, 1.3–1.5 mm. broad, rounded at apex, entire at margin, few-nerved; petals 4, thin-carnose, obovate-oblong, 2–2.5 mm. long, 1.3–1.5 mm. broad, rounded, entire, soon caducous; androecium erect, 1.3–1.5 mm. long, the stalk carnose, subterete or lightly angled, about 0.5 mm. long, the stamens about 12, congested on the subglobose distal portion of the androecium; filaments carnose, stout, 0.1–0.15 mm. long, the anthers horizontally affixed, peltate, 0.4–0.6 mm. in diameter, 4–8-loculed, dehiscing by a continuous lateral cleft; gynaecium-rudiment lacking; fruit solitary, subsessile on older branchlets, subglobose or slightly flattened, at maturity up to 5.5 cm. in diameter (ex Brass), with subpersistent sepals at base, 8–12-costate (probably inconspicuously so when fresh), the seeds 8–12, imbedded in somewhat fibrous pulp.

Of the cited specimens, only *Brass 7310* bears flowers; the other Brass specimens are in fruit, no. *7006* having unusually large leaves and the only mature fruits; the Carr specimens are sterile. From the staminal arrangement, the described species is surely a member of § *Hebradendron*, in which, however, it is not closely allied to the only

other Papuasian species, *G. fusco-petiolata* Lauterb., a species with free stamens. *Garcinia subtilinervis* is readily distinguished from other members of § *Hebradendron* by its few stamens aggregated and subsessile on a short androecium, by its small flowers, and by its thin acuminate leaf-blades.

Garcinia (§ *Daedalanthera*) **Hunsteinii** Lauterb. Bot. Jahrb. **58**: 40. *fig. 8.* 1922.

NETHERLANDS NEW GUINEA: 2–6 km. southwest of Bernhard Camp, Idenburg River, alt. 800–1200 m., *Brass & Versteegh 12536, 13154, 13531* (trees 25–30 m. high, rare or occasional in primary rain-forest on ridges, the trunk 39–47 cm. diam., the crown small, not wide-spreading, the bark 4–9 mm. thick, gray, fairly smooth, with a little yellow latex, the wood yellow to brown; young fruits green, the ripe ones red).

Reported as fairly abundant between 1000 and 1500 m. elevation in the adjacent portion of Northeastern New Guinea, *G. Hunsteinii* is apparently here first reported from the Netherlands section of the island. Our specimens are in fruit, but agree very well with the original description and figure; they have leaf-blades often slightly larger (up to 10.5 cm. long and 4.5 cm. broad) than those originally described. The coriaceous bluntly acuminate leaf-blades with comparatively few and immersed lateral nerves distinguish the species.

Garcinia (§ *Daedalanthera*) **Schraderi** Lauterb. Bot. Jahrb. **58**: 43. 1922.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. about 2680 m., *Brass & Versteegh 10478* (tree 26 m. high, common in ridge-forests, the trunk 33 cm. diam., the crown not wide-spreading, the bark 11 mm. thick, with yellow latex, brown, fairly rough, the wood soft, yellowish; flowers yellow; young fruits green, the ripe ones brown); 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1780 m., *Brass & Versteegh 11196* (tree 27 m. high, common in primary forest on the slope of a ridge, the trunk 47 cm. diam., the crown not wide-spreading, the bark 10 mm. thick, dark brown, fairly rough, with yellow latex, the sap-wood light brown, the heart-wood dark brown). NORTHEASTERN NEW GUINEA: Morobe District, Ogeramnang, alt. 1550–1850 m., *Clemens 4737* (tall tree on forest-ridge, the trunk at least 45 cm. diam.; flowers green), *4622, 5081, 6246.*

The species has previously been reported only from Northeastern New Guinea; it is apparently of considerable abundance at an altitude unusually high for the genus.

Garcinia (§ *Daedalanthera*) **Archboldiana** sp. nov.

Arbor glabra ad 25 m. alta, ramulis cinereis crassis (apicem versus 3–4 mm. diametro) juventute complanatis demum subteretibus et rugosis, petiolis 2–3 mm. crassis leviter canaliculatis 6–10 mm. longis nigrescentibus, basi foveola elliptica praeditis; laminis tenuiter coriaceis siccitate fusco- vel viridi-olivaceis elliptico-oblongis, 8–15 cm. longis, 3–6 cm. latis, basi attenuatis et in petiolum decurrentibus, apice rotundatis vel late obtusis, margine integris et anguste recurvatis, costa supra leviter elevata et canaliculata subtus prominente, nervis lateralibus utrinsecus numerosissimis (1–1.5 mm. distantibus et rete venularum irregulariter conjunctis) patentibus nonnunquam furcatis utrinque prominulis nervo marginali conjunctis, venulis subimmersis vel minute prominulis; floribus ♂ paucis (1–3 per inflorescentiam) ex pulvinis inconspicuis in axillis foliorum mox delapsorum orientibus, bracteis coriaceis minutis pluribus subtentis; pedicellis crassis (2–3 mm. diametro) saepe verrucosis 4–6 mm. longis; sepalis 4 imbricatis late orbicularibus concavis rotundatis integris, 2 exterioribus tenuiter coriaceis, circiter 2 mm. longis, 3.5–4 mm. latis, 2 interioribus papyraceis, circiter 4 mm. longis, 6–7.5 mm. latis; petalis 4 imbricatis carnosis late ellipticis, 7–10 mm. longis, 5–7 mm. latis, apice rotundatis, margine obscure undulatis; phalangibus 4 basi connatis profunde et conspicue lobatis, 5–6 mm. longis, apicem versus copiose antheriferis; staminibus numerosissimis, antheris subsessilibus subpeltatis vel ellipsoideis, 0.3–0.4 mm. diametro, loculis 3 vel 4 rimis brevibus horizontalibus apicali-lateralibus dehiscentibus; ovario nullo.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, alt. 300 m., *Brass & Versteegh 13596* (TYPE), April 20, 1939 (tree 25 m. high, rare in primary rain-forest on a ridge, the trunk 64 cm. diam., the crown not wide-spreading, the bark 7 mm. thick, brown, scaly, with some yellow sap, the wood light brown; flowers white).

Garcinia Archboldiana is one of a group of three new species of § *Daedalanthera* characterized by a reduction in the number of anther-locules and the absence of a gynaecium-rudiment in the staminate flowers. These three species are related to *G. Schraderi* Lauterb. and *G. Pullei* Lauterb., differing from both by the anthers and by obvious foliage-characters. *Garcinia Archboldiana* has large leaf-blades and very large flowers for this group of species, and is further characterized by numerous secondary nerves and deeply divided phalanges. The four primary phalanges, in fact, are difficult to observe, as the numerous finer divisions appear essentially free from each other. The extremely small and numerous anthers, with only 3 or 4 locules, also distinguish the new species.

Two other specimens from the same region are possibly conspecific with the type of the new species; these are: 6 km. southwest of Bernhard Camp, alt. 1200 m., *Brass 13011* (tree 25 m. high, in minor canopy of rain-forest, the trunk about 50 cm. diam., the bark smooth, brown; fruit green); 15 km. southwest of Bernhard Camp, alt. 1780 m., *Brass & Versteegh 11199* (tree 25 m. high, occasional in primary forest on the slope of a ridge, the trunk 53 cm. diam., the crown not wide-spreading, the bark 4 mm. thick, scaly, brown, with dark yellow sap, the wood light brown; young fruit green). These plants, occurring at substantially higher elevations than the type, differ from it in their somewhat coarser leaf-blades and petioles; their fruits are subglobose, up to 3 cm. in diameter, with stout pedicels and conspicuous stigmas. Lacking specimens from intermediate elevations, I hesitate definitely to refer these two specimens to *G. Archboldiana*.

Garcinia (§ *Daedalanthera*) **Engleriana** sp. nov.

Arbor glabra ad 28 m. alta, ramulis fusco-cinereis crassis (apicem versus 3–4 mm. diametro et complanatis) demum subteretibus et rugosis; petiolis nigrescentibus circiter 2 mm. diametro semiteretibus 5–8 mm. longis, basi foveola conspicua margine incrassata praeditis; laminis subcoriaceis siccitate fusco-olivaceis elliptico- vel obovato-oblongis, 5–9.5 cm. longis, 2.5–4.5 cm. latis, basi attenuatis et in petiolum decurrentibus, apice rotundatis vel late obtusis, margine integris et interdum conspicue revolutis, costa supra leviter elevata subtus prominente, nervis lateralibus utrinsecus numerosis (1–1.5 mm. distantibus) patentibus raro furcatis utrinque prominulis nervo marginali conjunctis, rete venularum inconspicuo subimmerso; floribus ♂ sub anthesi 1–4 per inflorescentiam 13–15 mm. diametro ex pulvinis conspicuis in axillis foliorum demum delapsorum orientibus, bracteis minutis deltoideis numerosis subtentis; pedicellis 5–11 mm. longis circiter 2 mm. crassis saepe leviter quadrangulatis; sepalis 4 papyraceis vel tenuiter coriaceis semiorbicularibus concavis rotundatis integris, 2 exterioribus 1.5–3 mm. longis et 2.5–3.5 mm. latis, 2 interioribus 5–6 mm. longis et latis; petalis 4 (vel raro 5) tenuiter carnosis obovato-oblongis, 7–8 mm. longis, 5–6 mm. latis, rotundatis, margine anguste scariosis et subintegris vel obscure undulatis; phalangibus circiter 16 patentibus carnosis 5–6 mm. longis, basi connatis, stipite basim versus 1–2 mm. diametro, ramulis paucis apicem versus; staminibus 15–20 per phalangem, filamentis carnosis brevibus (ad 0.4 mm. longis) vel subnullis, antheris subpeltatis vel ellipsoideis, 0.6–0.8 mm. diametro, margine undulatis, loculis 3–7 rimis brevibus horizontalibus apicali-lateralibus interdum confluentibus dehiscentibus; ovario nullo.

NETHERLANDS NEW GUINEA: 18 km. southwest of Bernhard Camp, Idenburg River, alt. 1970 m., *Brass & Versteegh 12508* (TYPE), Feb. 7, 1939 (tree 28 m. high, common in primary forest on slope of a ridge, the trunk 52 cm. diam., the crown not wide-spreading, the bark 4 mm. thick, brown, with yellow latex, the wood white; flowers white); 15 km. southwest of Bernhard Camp, alt. 1800 m., *Brass 12099* (tree 25 m. high, co-dominant in mossy forest, the trunk shortly spurred at base, the bark pale brown, lenticellate, with copious yellow latex; flowers white).

Like the preceding new species (*G. Archboldiana*), *G. Engleriana* differs from other species of the section in its deeply divided phalanges and comparatively few anther-locules. In the present species the phalanges are so deeply divided that the presumably fundamental four are no longer discernible. The anthers are larger than those of *G. Archboldiana* and there are obvious floral and foliage differences between the two species.

Garcinia (§ *Daedalanthera*) **idenburgensis** sp. nov.

Arbor glabra ad 33 m. alta, ramulis fusco-cinereis apicem versus 1.5–2 mm. crassis obscure quadrangulatis demum teretibus; petiolis nigrescentibus circiter 1.5 mm. diametro leviter canaliculatis 7–11 mm. longis, basi foveola inconspicua ornatis; laminis subcoriaceis siccitate fusco-viridibus obovato-ellipticis, 7–11 cm. longis, 3.5–5 cm. latis, basi attenuatis et in petiolum decurrentibus, apice obtuse cuspidatis, margine integris et minute revolutis, costa supra paullo subtus valde elevata, nervis lateralibus utrinsecus numerosis (1–1.5 mm. distantibus) erecto-patentibus raro furcatis utrinque planis vel minute prominulis nervo marginali conjunctis, venulis immersis obscuris; floribus ♂ 5–16 per inflorescentiam sub anthesi 7–8 mm. diametro ex pulvinis conspicuis (3–5 mm. diametro) in axillis foliorum saepe delapsorum orientibus, bracteis minutis numerosis suffultis; pedicellis sub anthesi 5–8 mm. longis gracilibus (0.3–0.5 mm. diametro); sepalis 4 papyraceis vel submembranaceis, oblongis vel obovato-oblongis, apice rotundatis, margine integris, 2 exterioribus valde concavis circiter 2.5 mm. longis et latis, 2 interioribus tenuioribus, 3.5–4 mm. longis, circiter 3 mm. latis; petalis 4 sub anthesi erecto-patentibus tenuiter carnosis elliptico- vel obovato-oblongis, 4.5–5 mm. longis, circiter 3 mm. latis, rotundatis, integris; phalangibus 4 carnosis 2.5–3 mm. longis copiose ramulosis, basi connatis; staminibus apicem phalangis versus aggregatis 30–35 per phalangem, antheris subsessilibus subpeltatis carnosis 0.5–0.6 mm. diametro, loculis plerumque 4 rimis distinctis parvis horizontalibus apicali-lateralibus dehiscentibus; rudimento gynaecii nullo vel minute pulvinato.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, alt. 100 m., *Brass & Versteegh 13570* (TYPE), April 15, 1939 (tree 33 m. high, frequent in primary rain-forest on the lower mountain-slopes, the trunk 62 cm. diam., the crown not wide-spreading, the bark 5 mm. thick, brown, scaly, with some dark yellow latex, the wood brown; flowers white).

Garcinia idenburgensis seems related to *G. Pullei* Lauterb., from which it differs in its thicker and larger leaf-blades with less obvious venation, larger flowers, and anthers with fewer locules (those of *G. Pullei* having 10–20 locules). The flowers of *G. idenburgensis* are more numerous and smaller than those of the preceding two new species, while the phalanges are clearly four.

Garcinia platyphylla sp. nov.

Arbor glabra ad 20 m. alta, ramulis crassis fuscis apicem versus complanatis inferne subteretibus; petiolis rugosis semiteretibus 2–3 mm. crassis 7–17 mm. longis, basi foveola conspicua coriacea margine ad 3 mm. incrassata praeditis; laminis tenuiter coriaceis late ellipticis vel obovato-ellipticis, 10–20 cm. longis, 6–14.5 cm. latis, basi obtusis et petiolum paullo decurrentibus, apice obtusis vel rotundatis, margine integris et paullo recurvatis, costa valida supra paullo elevata et striata subtus prominente, nervis lateralibus numerosissimis (1–3 mm. distantibus rete venularum irregulariter conjunctis) erecto-patentibus rectis utrinque prominulis nervo marginali conjunctis, venulis indistincte prominulis; inflorescentiis ♂ cymosis terminalibus ut videtur 10–20-floris (sed floribus ante anthesi saepe delapsis) 3–5 cm. longis et latis, pedunculo brevi et ramulis paucis crassis, bracteis coriaceis concavis ovato-deltoideis subacutis 2–4 mm. longis; floribus apice ramulorum inflorescentiarum binis vel ternatis, pedicellis ad 5 mm. longis apice bibracteolatis et articulatis; sepalis 4 imbricatis papyraceis concavis semiorbicularibus integris, 2 exterioribus circiter 3 mm. longis et 4.5 mm. latis, 2 interioribus circiter 4 mm. longis et 6 mm. latis; petalis 5 (immaturis) carnosis oblongo-obovatis, alabastro circiter 5 mm. longis et 4 mm. latis, rotundatis, integris; toro androecii carnoso subcupuliformi margine elevato, staminibus 40–50 apicem tori versus congestis, antheris subsessilibus immaturis ut videtur obovoideo-oblongis (0.5–0.8 mm. longis) 2(vel 3–4?)-loculatis, rimis longitudinalibus lateralibus dehiscentibus (?); rudimento gynaecii circiter 1.3 mm. longo, stipite carnoso, stigmate circiter 0.6 mm. diametro minute ruguloso; fructibus (inflorescentiis fructiferis non visis) elongato-ovoideis, ad 5.5 cm. longis et 2.5 cm. latis, basi inconspicue stipitatis et sepalis persistentibus suffultis,

apicem versus gradatim attenuatis, apice ipso obtusis et stigmate sessili 4–5 mm. diametro bilobato ruguloso coronatis, extra levibus, pericarpio siccitate coriaceo 0.5–1 mm. crasso, seminibus 2 elongato-ovoideis rugulosis, dissepimento membranaceo, pulpo ut videtur sparso.

SOLOMON ISLANDS: Bougainville: Siwai, *Waterhouse 108* (NY, TYPE, Y), Oct. 1932 (tree 8–9 m. high; native name: *matumatu*); Koniguru, Buin, alt. 900 m., *Kajewski 2016* (tree up to 20 m. high, common in rain-forest; native name: *nakamolo*).

The type collection bears immature staminate flowers, the Kajewski specimen being accompanied by detached fruits. As these two specimens are nearly identical in the details of their foliage, I have little hesitation in referring them to the same species, although the fruit of the second is not of the type commonly found in *Garcinia*. Comparison with other species of the region leaves little doubt that a new species is represented, but it seems inadvisable at present to refer it to a section. The flowers, unfortunately, are not sufficiently mature to permit the structure of the anthers to be entirely understood; it seems probable that a new section may eventually be desirable for this species. However, it is apparent that the anthers are subsessile on the margin of a continuous and somewhat cupuliform structure surrounding the gynaecium-rudiment. This arrangement is suggestive of § *Conocentrum*. The young anthers of our plant are crowded and appear to have three or four locules, but more mature anthers seem to be 2-loculed and longitudinally dehiscent, as in § *Cambogia*. The precise shape of the floral axis of the new species is not found in § *Cambogia*, which, furthermore, appears never to have only two cells in the ovary. *Garcinia platyphylla* is further characterized by its thick leaf-blades with numerous lateral nerves, its cymose inflorescences, and its 5 petals.

PENTAPHALANGIUM Warb.

Pentaphalangium latissimum (Miq.) Lauterb. Bot. Jahrb. **58**: 46. 1922.

Garcinia latissima Miq. Ann. Mus. Bot. Lugd.-Bat. **1**: 209. 1864; Pierre, Fl. Forest. Cochinch. **2**: XXXVI. 1883; Vesque in DC. Monogr. Phan. **8**: 338. 1893.

NETHERLANDS NEW GUINEA: 2 km. southwest of Bernhard Camp, Idenburg River, alt. 800 m., *Brass & Versteegh 13196* (tree 25 m. high, frequent in primary rain-forest on the slope of a ridge, the trunk 56 cm. diam., the crown not wide-spreading, the bark 17 mm. thick, black, scaly, with a fair amount of light yellow latex, the wood yellow-brown; fruits green).

The species was based on a specimen collected in Halmahera by Teysmann and subsequently cultivated at Buitenzorg; a sterile specimen from this cultivated plant (no. VI, c, 28) is available in the herbarium of the New York Botanical Garden. Although the species is included by Lauterbach in his treatment of the New Guinea Guttiferae, his description and his new combination are apparently based entirely on a staminate specimen from the Buitenzorg plant. It seems, therefore, that the collection by Brass & Versteegh is the first of the species from New Guinea. Our specimen has foliage which is an excellent match for that of the Buitenzorg plant, and its fruits agree very well with those described by Pierre and Vesque.

Pentaphalangium pachycarpum sp. nov.

Arbor glabra ad 24 m. alta, ramulis crassis apicem versus 4–8 mm. diametro subteretibus rugosis fusco-cinereis, novellis in nodis paullo applanatis; petiolis validis rugosis circiter 3 mm. diametro leviter canaliculata 15–32 mm. longis, basi foveola elliptica margine valde coriacea et elevata praeditis; laminis coriaceis siccitate fuscis obovato- vel oblongo-ellipticis, 9–22 cm. longis, 5.5–11.5 cm. latis, basi subacutis vel attenuatis et in petiolum decurrentibus, apice rotundatis interdum emarginatis, margine integris et anguste recurvatis, costa valida supra conspicue elevata subtus prominente carinata, nervis secundariis utrinsecus numerosis (1–3 mm. distantibus, alternatis debilioribus) patentibus nonnunquam furcatis utrinque prominulis vel supra subimmersis nervo marginali inconspicuo conjunctis, venulis immersis; inflorescentiis ♀ terminalibus crassis ad 3 cm. longis breviter spicatis 3–7-floris, pedunculo brevi et rhachi rugosis subteretibus 5–6 mm. crassis, floribus sessilibus bracteis papyraceis deltoideo-suborbicularibus rotundatis integris circiter 2 mm. longis et 4–5 mm. latis subtentis; sepalis 3 vel 4 imbricatis tenuiter coriaceis semiorbicularibus, circiter 4 mm. longis, 6–8 mm. latis, apice rotundatis, margine anguste scariosis et integris; petalis 5 vel 6 papyraceis obovato-oblongis, 10–11 mm. longis, 8–10 mm. latis, apice rotundatis, basim versus angustatis, margine scariosis et integris saepe inflexis; phalangibus 5 vel 6 trienti inferiori petalorum adnatis inconspicuis 2–3 mm. longis irregulariter divisis ut videtur interdum nullis; ovario breviter cylindrico rugoso sub anthesi 4–5 mm. diametro, stigmate carnoso circiter 5 mm. diametro obscure et regulariter ruguloso, loculis 2 uniovulatis; fructibus elongato-ovoideis, maturitate ad 10 cm. longis et 4.5 cm. latis, basi rotundatis et sepalis persistentibus suffultis, apice stigmate conspicuo ad 1 cm. diametro coronatis, pericarpio siccitate crasse coriaceo (lignoso?) 4–7 mm. crasso utrinque sublevi, semini-

bus 2 lanceolato-ovoideis, ad 8 cm. longis et 2 cm. latis, siccitate coriaceis, apicem versus angustatis, extra conspicue impresso-reticulatis.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, alt. 50–100 m., *Brass & Versteegh 13550* (TYPE), April 10, 1939 (tree 24 m. high, occasional in primary rain-forest on lower mountain-slopes, the trunk 72 cm. diam., the crown fairly wide-spreading, the bark 10 mm. thick, black, scaly, with some white latex, the wood yellow-brown; flowers white; young fruits green, the ripe ones red), *Brass 14065* (tree about 20 m. high, common in flooded rain-forest of river-plain; fruits green).

The position of this plant in *Pentaphalangium* is indicated by the leaf-texture, fruit-shape (suggesting that of *P. carolinense* Lauterb.), and position of the flowers, as well as by the presence of staminodial phalanges on the petals of the pistillate flowers. On the type-specimen very few flowers are available, and the above description, based only on two dissections, may require future amplification; no. *14065* bears only foliage and fruits. Of the two flowers dissected, one has six petals with obvious but not conspicuous phalanges, while the other, curiously, has five entirely smooth petals.

From its only close ally, *P. latissimum* (Miq.) Lauterb., the new species differs in its somewhat smaller leaves, proportionately broader sepals and petals, and much longer and proportionately narrower fruits.

Pentaphalangium Brassii sp. nov.

Arbor glabra ad 20 m. alta, ramulis crassis apicem versus 4–8 mm. diametro valde rugosis, novellis complanatis vel leviter quadrangulatis demum subteretibus; petiolis rugosis 2–4 mm. crassis canaliculatis 10–25 mm. longis, basi foveola elliptica margine valde crassa et elevata praeditis; laminis subcoriaceis oblongo-ellipticis, 13–32 cm. longis, 6–16 cm. latis, basi acutis vel attenuatis et in petiolum decurrentibus, apice rotundatis vel leviter emarginatis, margine integris et paullo recurvatis, costa valida supra elevata subtus prominente, nervis lateralibus utrinsecus numerosis (1–3 mm. distantibus, alternatis debilioribus) rectis plerumque simplicibus utrinque prominulis nervo marginali conjunctis, rete venularum inconspicuo vel in laminis novellis leviter prominulo; inflorescentiis ♀ terminalibus crassis 1.5–2.5 cm. longis cymosis vel breviter spicatis 3–7-floris, pedunculo brevi rugoso 3–4 mm. crasso, bracteis basi ramulorum inconspicuorum oblongis acutis ad 8 mm. longis; floribus sessilibus sub anthesi 22–25 mm. diametro, bracteis papyraceis deltoideis acutis carinatis 3–4 mm. longis subtentis; sepalis 4 coriaceis imbricatis late ovato-semiorbicularibus, 4–6 mm. longis, 7–8 mm. latis,

rotundatis, margine scariosis et integris; petalis 5 papyraceis obovato-oblongis, 13–14 mm. longis, 8–9 mm. latis, basim versus angustatis, margine integris vel obscure erosulis, venulis distaliter inconspicue reticulatis; phalangibus inconspicuis 1.5–2 mm. longis pauciramosis basi petalorum adnatis; ovario breviter subcylindrico sulcato sub anthesi 3–5 mm. diametro apicem versus obscure ruguloso, stigmate conspicuo carnoso convexo 6–7 mm. diametro minute ruguloso, loculis 3 uni-ovulatis; fructibus ovoideis, maturitate ad 9 cm. longis et 5 cm. latis, basi rotundatis et sepalis persistentibus suffultis, apice stigmate ad 1 cm. diametro coronatis, pericarpio coriaceo siccitate 2–5 mm. crasso utrinque sublevi, dissepimentis subcoriaceis, seminibus 3 (interdum 1 vel 2) oblongo-ovoideis, ad 7 cm. longis et 3 cm. latis, siccitate valde coriaceis, apicem versus gradatim angustatis, testa subcoriacea inconspicue impresso-reticulata.

British New Guinea: Lower Fly River, east bank opposite Sturt Island, *Brass 8206* (type), Oct. 1936 (dense-foliaged tree 20 m. high, common on banks of river in flood-plain rain-forest, the trunk cylindric, the bark dark, rough, fissured, the latex cream colored, the branches short and weak; flowers white, the stigma yellow; ripe fruit red).

Pentaphalangium Brassii bears a close resemblance to the preceding new species (*P. pachycarpum*), but differs in its slightly more slender pistillate inflorescence with acute and carinate rather than rounded bracts, in its longer and proportionately narrower petals with the staminodial phalanges at the base rather than higher on the face of the petal, in its 3 rather than 2 ovary-locules, in the thinner pericarp of its fruit, and in its proportionately broader seeds with less obvious surface reticulation. The flowers dissected all agree in having 4 sepals, 5 petals, and 3 ovary-locules, but of course additional material may prove these numbers unstable.

Pentaphalangium solomonense sp. nov.

Arbor glabra 10 m. alta, ramulis fuscis apicem versus subcomplanatis et 3–4 mm. crassis demum subteretibus rugosis lenticellatis; petiolis rugosis semiteretibus circiter 2 mm. crassis 10–15 mm. longis, basi foveola elliptica margine coriacea et valde (ad 2 mm.) elevata praeditis; laminis crasse coriaceis siccitate fuscis obovato-ellipticis, 7–13.5 cm. longis, 3.5–7 cm. latis, basi subattenuatis et in petiolum decurrentibus, apice rotundatis vel inconspicue emarginatis, margine integris et leviter recurvatis, costa supra subplana vel paullo elevata subtus prominente carinata, nervis secundariis utrinsecus numerosis (1–1.5 mm. distantibus) erecto-patentibus utrinque prominulis vel supra subimmersis mar-

ginem versus saepe furcatis nervo marginali conjunctis, rete venularum subtus interdum leviter prominulo; inflorescentiis ♀ terminalibus ad 3 cm. longis trichotome cymosis (3–)9–15-floris (sub anthesi floribus paucis), pedunculo brevi et ramulis paucis rugosis 2–3 mm. crassis saepe leviter angulatis, bracteis basi ramulorum coriaceis oblongis subacutis 4–7 mm. longis, floribus sessilibus bracteis coriaceis deltoideo-semiorbicularibus rotundatis circiter 2 mm. longis et 3–4 mm. latis subtentis; sepalis 4 late imbricatis coriaceis concavis semiorbicularibus, 3.5–5 mm. longis, 5–6 mm. latis, rotundatis, margine scariosis et integris; petalis 5 (raro 4) carnosis obovato-oblongis (in specimine nostro immaturis), 6–7 mm. longis, 3–4 mm. latis, apice rotundatis, basim versus angustatis, margine integris; phalangibus trienti inferiori petalorum adnatis inconspicuis simplicibus stamina 1–3 sterilia gerentibus (filamentis carnosis circiter 0.2 mm. longis, antheris subglobosis vel transverse ellipsoideis 0.5–0.8 mm. diametro); ovario obovoideo-cylindrico ante anthesim 2–3 mm. diametro sulcato carnoso, stigmate conspicue ruguloso circiter 2.5 mm. diametro margine irregulariter lobulato, loculis 2 uniovulatis; fructibus juvenilibus elliptico-subglobosis, basi rotundatis et sepalis persistentibus suffultis, apice stigmate bilobato ruguloso ad 3.5 mm. diametro coronatis, pericarpio coriaceo.

SOLOMON ISLANDS: N'Gela Group (Florida Islands), Olevuga: *Brass 3484* (TYPE), Jan. 16, 1933 (tree 10 m. high, solitary in a rain-forest gully on grassland, the branches stiffly spreading, the bark hard, rough, dark brown, with a white sticky latex, the leaf-blades stiff, with pale midribs; immature fruits pale yellow, with black persistent stigmas).

Compared with the species thus far known in *Pentaphalangium*, *P. solomonense* is unusual in having the staminodial phalanges of the petals of its pistillate flowers composed of 1–3 abortive stamens; as a rule these phalanges are merely irregularly laciniate tissue with no approximation of true anthers. Conspicuously different from the Papuan species thus far known, *P. solomonense* seems most closely related to *P. carolinense* Lauterb., from which it differs in its much thicker leaf-texture; in *P. carolinense* the phalanges of the pistillate flowers have numerous branches (Kanehira, Fl. Micrones. 241. *fig. 112, C.* 1933).

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

PLANTAE PAPUANAE ARCHBOLDIANAE, VII*

E. D. Merrill and L. M. Perry

This paper is a continuation of our study of the smaller families of the Papuasian collections. Lack of authentic material for comparison, coupled with the fluidity of generic lines, has made the identification of the Vitaceae a particularly difficult task. The family is in great need of critical revision, and, in order to clear up some of the loose concepts, it should be surveyed as a whole rather than geographically.

VITACEAE

Ampelocissus Planchon

Ampelocissus acetosa Planchon, Vigne Américc. 96. 1885; Planchon in DC. Monog. Phan. **5**: 381. 1887; Domin, Bibl. Bot. **22**: 925. 1927.

Cissus acetosa F. v. Muell. Trans. Phil. Inst. Vict. **3**: 24. 1859.

Vitis acetosa F. v. Muell. Pl. Vict. **1**: 94. 1860–62; Benth. Fl. Austr. **1**: 449. 1863; F. M. Bail. Queensl. Fl. **1**: 282. 1899.

British New Guinea: Western Division, Wassi Kussa River, Tarara, *Brass 8647,* January 1937, rambling amongst grass in savannah-forest (branches, petioles and lower surface of leaves glaucous; inflorescence red); Daru Island, *Brass 6448,* April 1936, rare small climber in edge of light rain-forest (large bunches of grape-like fruit); Laloki River, Haga, *Brass 900,* January 1926, coast savannahs (flowers reddish; fruit black, edible, slightly acrid).

With no available material for comparison, and with the similarity between the Papuan specimens and the description of this Queensland species so marked, we have hesitated to place these collections elswhere at present. *Ampelocissus pauciflora* Merr. of the Philippine Islands is a closely related species.

Tetrastigma Planchon

Tetrastigma Pullei Lauterb. Bot. Jahrb. **59**: 514. 1925.

Netherlands New Guinea: 9 km. northeast of Lake Habbema, *Brass 10247A,* October 1938, alt. 2800 m., common climber of second growths in forest openings.

*(Botanical Results of the Richard Archbold Expeditions) See Jour. Arnold Arb. **22**: 254–270. 1941.

Although this collection seems to belong to *Tetrastigma Pullei* Lauterb., it seems worth mentioning that the leaves are coriaceous or very firmly chartaceous, the terminal leaflets vary from 1.7 to 4 cm. long and up to 3.2 cm. broad, the widely spreading primary veins are impressed above (sometimes also branched so that the upper leaf-surface appears rugose) and prominent beneath.

Tetrastigma Lauterbachianum Gilg in Engler & Prantl, Nat. Pflanzenfam. **3**(5): 447, *f. 218 A–E.* 1896; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 430. 1900; Lauterb. Bot. Jahrb. **59**: 510. 1925.

SOLOMON ISLANDS: Malaita Island, Quoimonapu, *Kajewski 2319*, December 1930, common in rain-forest at sea level.

The species has been recorded previously from New Guinea and the Bismarck Archipelago.

Cissus Linnaeus

Cissus conchigera Ridley, Trans. Linn. Soc. Bot. II. **9**: 31. 1916.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, *Brass 13075*, March 1939, alt. 850 m., climbing in *Saccharum* on flood banks of river (flowers greenish yellow; fruit black). BRITISH NEW GUINEA: Palmer River, 1 mile above Black River Junction, *Brass 6942*, June 1936, wet clayey soil on riverside landslip (low scrambling brown-pubescent shrub; flowers yellow); Lake Daviumbu, Middle Fly River, *Brass 7479*, rain-forest, very common large canopy liana.

Without access to the type-specimens, we are unable to distinguish *Cissus Ledermannii* Lauterb. from this species. The lower leaf-surfaces in the Fly River collections are much more pubescent than those of the collection from Netherlands New Guinea, but all surely belong to the same species.

Cissus indica Rottler, Ges. Naturf. Freund. Berl. Neu. Schrift. **4**: 183. 1803.

Cissus adnata Roxb. Fl. Ind. **1**: 423. 1820.

On account of some doubt as to the identity of the plant, the name *Cissus indica* Rottler was discarded by Planchon. There seems to be, however, an authentic specimen in Willdenow's herbarium, and, in the light of the numerous present day collections, this ought to be re-examined together with the originals of *C. adnata* Roxb. and *C. assamica* (Laws.) Craib. These species have been variously interpreted. Of

the Indo-Malaysian material at hand, all of the earlier Indian collections have been distributed under the specific name *adnata*. In this are three entities as to types of pubescence: (1) pubescence of single several-celled hairs; (2) pubescence of malpighioid hairs, the leaf tending to become glabrous except along the nerves on the lower surface; (3) pubescence of malpighioid hairs, the leaf tending to remain densely pubescent on the lower surface. In addition, in the flowers of plants clothed with simple hairs, there are a few hairs around the base of the style on the disk; in the other two, the disk of the flowers is glabrous. The first, Gagnepain, Not. Syst. **1**: 353. 1911, has intepreted as *C. adnata* Roxb., a species unquestionably distinct from the other two entities designated as *C. assamica* (Laws.) Craib, and var. *pilosissima* Gagnep. respectively. Whether Gagnepain's interpretation is correct we cannot say, since he gives no indication of having had access to authentic material of *C. adnata* Roxb. and both species are reported from the same region. As a matter of fact, in the early and historic collections (some of which are cited by Gagnepain) at hand the material is badly mixed; hence, without the opportunity to examine the original specimens, and, considering the rather vague original descriptions, any decision in the matter must, of necessity, be arbitrary.

In the Papuan collections under consideration there are specimens which, we believe, represent both *C. adnata* Roxb. and *C. assamica* (Laws.) Craib as interpreted by Gagnepain. Of the former, we have a single specimen, *Schlechter 18896*, cited by Lauterbach, Bot. Jahrb. **59**: 519. 1925, under *C. repens* Lam. Unfortunately, we have not a single collection cited by Lauterbach under *C. adnata* Roxb.; hence, we are at a loss to know what entity he considered to be *C. adnata* Roxb. Further, we do not find in his work, "Die Vitaceen Papuasiens," any mention of *Hollrung 419*, the one collection of this complex from New Guinea cited by Gagnepain. In view of the nomenclatural dilemma outlined above, for the present we have assigned the following collections to:

Cissus assamica (Laws.) Craib, Kew Bull. **1911**: 31. 1911.

Vitis assamica Laws. Fl. Brit. Ind. **1**: 648. 1875.

Netherlands New Guinea: 15 km. southwest of Bernhard Camp, Idenburg River, *Brass 12397*, January 1939, alt. 1500 m., rain-forest, climbing in undergrowth on open bank of stream (flowers yellow; fruit immature); 4 km. southwest of Bernhard Camp, Idenburg River, *Brass 13064*, March 1939, alt. 850 m., in rain-forest seral growths, common scrambling shrub on river banks. British New Guinea:

Jawarere, *Brass 679*, November 1925, alt. ± 300 m., rain-forest. NORTHEASTERN NEW GUINEA: Bulung River, *Clemens 5341*, February 1937, alt. ± 800 m. SOLOMON ISLANDS: Bougainville Island, without definite locality, *Kajewski 1605*, March 1930, alt. 100 m., rain-forest (fruit black when ripe, 6 mm. long, 7 mm. diameter); Kugimaru, Buin, *Kajewski 1811*, June 1930, alt. 150 m., rain-forest (fruit shiny black when ripe, 6 mm. long 5.5 mm. diameter); Marmaromino, *Kajewski 2215*, September 1930, alt. 50 m., climbing in rain-forest trees.

Somewhat doubtfully we add *Kajewski 2410*, Berande, Guadalcanal Island. The leaves of this are larger and more membranaceous than in the other collections cited.

Cissus simplex Blanco Fl. Filip. 72. 1837; Merr. Enum. Philip. Fl. Pl. **3**: 7. 1923.

Cissus pyrrhodasys Miq. Fl. Ind. Bat. Suppl. **1**: 517. 1860.

SOLOMON ISLANDS: Guadalcanal Island, Uulolo, Tutuve Mountain, *Kajewski 2640*, May 1931, alt. 1200 m., common in rain-forest; Malaita Island, Quoimonapu, *Kajewski 2362*, December 1930, alt. 50 m., rain-forest.

These collections represent a small range extension eastward. The species is known from India through Malaysia. Possibly this is the entity which Lauterbach designated as *Cissus adnata* Roxb. var. *montana* in New Guinea.

Cissus ? hypoglauca A. Gray, Bot. U. S. Expl. Exped. 272. 1854; Planchon in DC. Monog. Phan. **5**: 519. 1887.

Vitis hypoglauca F. v. Muell. Pl. Vict. **1**: 94. *t. 10.* 1860–62; Benth. Fl. Austral. **1**: 450. 1863.

NORTHEASTERN NEW GUINEA: Ogeramnang, *Clemens 4970*, January 1937, alt. ± 1700 m., tall vine in forest.

This rather young specimen shows a very strong likeness to our Australian material of *Cissus hypoglauca* A. Gray. It differs in that the midrib on the lower surface of the leaflets, the petioles, petiolules, and the axis of the inflorescence are clothed more or less with a brownish tomentum. This is obviously partly deciduous, but whether it is wholly so as the plant arrives at maturity we cannot say.

Cayratia Jussieu

Cayratia grandifolia (Warb.) comb. nov.

Cissus grandifolia Warb. Bot. Jahrb. **18**: 199. 1893; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 428. 1900; Lauterb. Nov. Guin. **8**: 302. 1910; Rechinger, Denkschr. Math.-Naturw. Kaiserl.

Akad. Wissensch. **89**: 574 (Bot. Zool. Ergeb. Wiss. Forsch. Samoa-I. Neug.-Arch. Salomonsins. **5**: 132). 1913; Ridl. Trans. Linn. Soc. Bot. II. **9**: 31. 1916; Lauterb. Bot. Jahrb. **59**: 527. 1925.

British New Guinea: Western Division, Daru Island, *Brass 6396*, March 1936, rare in second growth rain-forest (robust liana); Sturt Island, Lower Fly River, *Brass 8195*, October 1936, rain-forest (large climber ascending to the tree-tops); Central Division, Nakeo District, Baroka, *Brass 3771*, April 1933, alt. 30 m., fairly common in the rain-forests (very large climber with thick flexible stems; leaflets somewhat convex, shining on both surfaces, nerves pale; petals greenish yellow). Solomon Islands: Bougainville Island, Kieta, *Kajewski 1577*, March 1930, at sea-level, rain-forest (common vine; fruit white-green when ripe, semi-transparent, flattened at the apex and the base, 9 mm. long, 14 mm. diameter, when dry 6 mm. long, 8 mm. diameter, ± rugose).

Although we have no authentic material for comparison, these collections agree reasonably well with the description of this species except that the pubescence on the lower surface of the leaves is confined to the midrib and the larger nerves.

Cayratia megacarpa (Lauterb.) comb. nov.

Cissus megacarpa Lauterb. Bot. Jahrb. **59**: 526. 1925.

This species is represented in our herbarium only by *Schlechter 16878*, a specimen cited in the original description.

Cayratia lineata (Warb.) comb. nov.

Cissus lineata Warb. Bot. Jahrb. **13**: 370. 1891.

Cayratia lineata var. **fusco-lanata** (Lauterb.) comb. nov.

Cissus lineata var. *fusco-lanata* Lauterb. Bot. Jahrb. **59**: 528. 1925; C. T. White, Jour. Arnold Arb. **10**: 236. 1929.

The two specimens of this variety at hand are *Schlechter 16775*, an isotype, and *Brass 1137*.

Cayratia japonica (Thunb.) Gagnep. Not. Syst. **1**: 349. 1911, Fl. Gén. Indo-Chine **1**: 983. *t.26. f.11–16.* 1912.

Vitis japonica Thunb. Fl. Japan 104. 1784.

Solomon Islands: Guadalcanal Island, Ululolo, Tutuve Mountain, *Kajewski 2600*, April 1931, alt. 1200 m., common in rain-forest (fruit black when ripe, flattened, 8 mm. long, 1.4 cm. diameter).

This collection agrees reasonably well with the material of this species from tropical Asia. *Cayratia japonica* (Thunb.) Gagnep. appears to be a wide-spread species, having been reported from China, Indo-China, Japan, Formosa, Java, the Philippines, Australia, New Caledonia, the

Loyalty Islands, and the Bismarck Archipelago. This seems to be the first record from the Solomon Islands.

Leea Linnaeus

Leea indica (Burm. f.) Merr. Philip. Jour. Sci. **14:** 245. 1919, Enum. Philip. Fl. Pl. **3:** 11. 1923.

Staphylea indica Burm. f. Fl. Ind. 75. *t. 23, f. 2.* 1768.

Leea sambucina Willd. Sp. Pl. **1:** 1177. 1797; Benth. in Hook. Lond. Jour. Bot. **2:** 214. 1843; Hemsl. Kew Bull. **1895:** 134. 1895; Valeton, Bull. Dept. Agric. Néerl. **10:** 31. 1907; Rechinger, Denkschr. Math.-Naturw. Kaiserl. Akad. Wissensch. **89:** 574. 1913; C. T. White, Proc. Roy. Soc. Queensl. **34:** 43. 1923; Lauterb. Bot. Jahrb. **59:** 531. 1925; Lam, Nat. Tijdschr. Nederl. Ind. **88:** 208. 1928; C. T. White, Jour. Arnold Arb. **10:** 237. 1929.

BRITISH NEW GUINEA: Fly River, 528 mile Camp, *Brass 6809,* common on river banks from camp to coast; Lower Fly River, east bank opposite Sturt Island, *Brass 8201A,* plentiful on river banks (sparsely branched tree 6–7 m. high; stem and branches hollow and inhabited by ants; branchlets corrugated; flowers green).

In addition to the above are two other collections which may possibly belong here; at least without further material we are hesitant about placing them elsewhere at present. The leaves are very much like those of *L. indica* (Burm. f.) Merr. but are minutely pilose on the nerves on the lower surface of the leaflets, and the leaflets have a very long acumen (up to 3 cm.); the inflorescence (in early anthesis) is very short (up to 12 cm. long) as compared to the usual form in this species.

NETHERLANDS NEW GUINEA: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass 12764,* February 1939, alt. 1200 m., on open banks of a small stream (tree 3 m. high). SOLOMON ISLANDS: San Cristobal Island, Waimamura, *Brass 2591,* August 1932, common in lowland rain-forests (sparsely branched tree 12 m. tall, supported on stilt roots 1 m. long; stems pithy; bark brown, lenticellate; flowers yellowish green; fruit compressed, fleshy, purple-black, 1.3 cm. diameter).

Leea solomonensis sp. nov.

Arbor usque 7 m. alta; ramulis minute ferrugineo-pubescentibus; foliis simpliciter pinnatis, in specimine typico 2-jugis; petiolo circiter 6 cm. longo et rhachi 7 cm. longa minute crispule ferrugineo-pubescentibus; foliolis ellipticis, ± 18 cm. longis, 8–10 cm. latis, basi obtusis vel late cuneatis, apice fractis, margine repando-dentatis, chartaceis, supra glabris, subtus parce crispule pubescentibus, subclathrato-reticulatis, venis primariis utrinsecus 15–17, patenti-adscendentibus prope marginem

arcuatis, supra distinctis, subtus prominulis; petiolulis lateralibus 1.4–2 cm. longis, terminali 4.2 cm. longo; paniculis minute crispule pubescentibus, in fructu 35 cm. longis; alabastris immaturis, calyce puberulo; petalis 5 basi connatis, apice inflexo-mucronatis valvatis, 6 mm. longa, extus apicem versus puberulis; staminibus 5; ovario glabro, stylo glabro striato; baccis depressis globosis, in sicco ± 1.5 cm. longis, 2.5 cm. diametro, 6-spermis.

SOLOMON ISLANDS: Guadalcanal Island, Ma-massa, Konga, *Kajewski 2488* (TYPE), February 1931, alt. 400 m., common in rain-forest (a very small tree up to 7 m. high; fruit red when ripe, 2.4 cm. long, 3 cm. diameter, flattened at the apex and the base).

In its loosely branching inflorescence *Leea solomonensis* appears to be related to *L. macropus* Lauterb. & K. Schum. It may be readily distinguished however, by the elliptic leaves obtuse rather than rounded at the base, and the minute crisp pubescence on the lower surface of the leaves.

Leea suaveolens sp. nov.

Arbor usque 10 m. alta; foliis simpliciter pinnatis, ? bijugis, petiolo ± 7 cm. longo, glabro vel puberulo; foliolis oblongo-ellipticis, 15–20 cm. longis, 7–9 cm. latis, basi subrotundatis paullo obliquis, apice acuminatis, acumine 2–2.5 cm. longo, margine grosse serrato-crenatis, subcoriaceis, glabris vel subtus costa atque axillis inter venas ac costam parce pubescentibus, tenuiter subclathrato-reticulatis, venis primariis utrinsecus 11–13, patenti-adscendentibus prope marginem arcuatis, in dentes marginis ipsius excurrentibus; petiolulis ± 1.5 cm. longis, puberulis interdum consperse glandulosis; paniculis puberulis subdivaricatim ramosis; floribus pentameris ad apices ramulorum 2–4-natis; pedicellis 5–6 mm. longis; calyce 3 mm. longo, campanulato, ± irregulariter lobato, extus puberulo interdum parce glanduloso; corolla 7 mm. longa, laciniis oblongis, 4.5 mm. longis, apice brevissime subcucullatis inflexo-mucronulatis, extus puberulis; staminibus 5, filamentis prope basim disci extus insertis atque in sulcis longitudinalibus disci immersis, antheris in alabastro intra discum inflexis, 1.8 mm. longis; disco cylindrico, 5 mm. longo, 5-dentato, dentibus emarginatis; ovario glabro, 1 mm. longo, stylo striato 3 mm. longo puberulo; baccis globosis, siccis 2.5 cm. diametro, 6-spermis.

SOLOMON ISLANDS: Ysabel Island, Tiratona, *Brass 3343* (TYPE), December 1932, alt. 600 m., common in rain-forests (densely foliaged tree up to 10 m. tall; leaves pale below; flowers cream-colored, sweetly perfumed; fruit globose, smooth, brown, up to 5 cm. diameter).

In the oblong-elliptic leaflets and the open inflorescence *Leea suaveolens* shows some resemblance to *L. macropus* Lauterb. & K. Schum. The latter, however, is a glabrous tree with flowers densely crowded at the apices of the ultimate branches of the inflorescence. In *L. suaveolens* the inflorescence is puberulous with scattered glands on the calyx and occasionally on the axis and the branches of the inflorescence; glands also occur on the rachis and the petiolules of the leaflets. Unfortunately, our material is too scanty to determine whether these are sufficiently constant to be used as a specific diagnostic character. The fruit of this species is somewhat larger than that reported for the other related species.

Leea macropus Lauterb. & K. Schum. Notizbl. Bot. Gart. Berl. **2:** 130. 1898; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 430. 1900, Nachtr. 313. 1905; Valeton, Ic. Bogor. **3:** 147. *t. 258.* 1908; Bak. f. Jour. Bot. **61:** Suppl. 11. 1923, l. c. **62:** 54. 1924; Lauterb. Bot. Jahrb. **59:** 530. 1925; Kaneh. & Hatus. Bot. Mag. Tokyo **52:** 415. 1938.

SOLOMON ISLANDS: San Cristobal, Balego-Nagonago, *Brass 2825,* September 1932, alt. 500 m., mountain rain-forests (sparsely branched spreading tree 6 m. tall; branches pithy, rather fleshy; leaves smooth and shining; flower buds yellow; unripe fruit brown, broadly pyriform, 2.5 cm. diameter).

Although we have no authentic material of this species for comparison, this collection corresponds too closely with Valeton's description and plate of K. Schumann's species to be placed elsewhere at present. Closely allied or possibly belonging to the same species is *Kajewski 1865,* a fruiting specimen with open inflorescence and bipinnate leaves. This material was collected on Bougainville Island.

Leea papuana sp. nov.

Arbuscula 2–2.5 m. alta, ramosa vel eramosa; foliis paucis sub apice caulis congestis, simpliciter pinnatis, 5-jugis; petiolo 17 cm. longo, rhachi 31 cm. longa 4-angulatis, supra canaliculatis, marginibus ventralibus alatis vel subalatis, glabris; petiolulis 6–12 mm. longis, crispo-alatis; foliolis anguste oblongis, 18–38 cm. longis, 6.5–10 cm. latis, basi obtusis vel subrotundatis, apice longe acuminatis, acumine 1.5–3 cm. longo, margine remotiuscule sinuato-dentatis, glabris, coriaceis, crebre clathrato-reticulatis, venis primariis utrinsecus 10–17, supra distincte manifestis, subtus perspicuis; panicula terminali conferta; axi 5–6 cm. longa; baccis brunneis globosis, ± 3.5 cm. diametro, 6-spermis.

BRITISH NEW GUINEA: Palmer River, 2 miles below Black River

Junction, *Brass 7325* (TYPE), July 1936, alt. 100 m., restricted to the muddy banks of flood-plain streams; uncommon (small tree, branched or unbranched, 2–2.5 m. high; leaves few, clustered at the apex of the stem below a dense terminal cluster of soft brown globose fruit ± 3.5 cm. diameter).

Leea tuberculata Lauterb., *L. coryphantha* Lauterb., and *L. heterodoxa* Lauterb. & K. Schum., all have more or less the aspect of *L. papuana*. Nevertheless, our new species may be distinguished from the first by its simply pinnate leaves, from the second by the coriaceous narrower and sinuate-dentate leaflets, and from *L. heterodoxa* Lauterb. & K. Schum. by the narrowly winged rachis.

CAMPANULACEAE

Wahlenbergia Schrader

Wahlenbergia confusa sp. nov.

Herba gracilis glabra; caulibus decumbentibus hinc inde ramosis; ramis 5–15 cm. longis, adscendentibus, saepe confertis, inferne foliosis, insuper nudis (1–6 cm.), unifloris; foliis alternis, sessilibus, linearioblongis vel fere lanceolatis, 4–7 mm. longis, 1.5–2 mm. latis, remote minuteque serrato-dentatis; calyce glabro, tubo circiter 2 mm. longo, cyathiformi, lobis lineari-lanceolatis acuminatis, 3 mm. longis; corolla cyanea, 1.6 cm. longa, infundibuliformi, 5-fida, lobis ovatis; staminibus in alabastris prope anthesim 5 mm. longis, antheris 2 mm. longis, filamentis post anthesim 3 mm. longis, minute pilosis, basi applanatis sursum gradatim angustatis, versus apicem filiformibus; stylo longitudine tubi corollae, a medio ad apicem puberulo; stigmatibus 3, post anthesim revolutis; capsulis ± 5 mm. diametro, subglobosis, calycis lobis reflexis coronatis, 3-locularibus, apice 3-valvis, dehiscentibus; seminibus ellipsoideis, vix 1 mm. longis.

NETHERLANDS NEW GUINEA: 5 miles northeast of Wilhelmina-top, *Brass 9399* (TYPE), August 1938, alt. 3440 m., plentiful under the banks of grassland streams (ascending herb with striking blue flowers); 11 km. northeast of Wilhelmina-top, *Brass & Myer-Drees 9721*, September 1938, alt. 3400 m., rather wet open places along a small river (herbaceous; corolla blue).

The species most closely approaches the description of *Wahlenbergia eurycarpa* Domin, but that is an erect plant with a larger capsule. As compared with *W. gracilis* A. DC., this plant is readily separated by the one-flowered inflorescence, and the flowers are distinguishable by the outline of the filaments; in this species the filament gradually tapers

to a filiform apex, in *W. gracilis* A. DC. the flattened and pubescent base of the filament very abruptly narrows into the short filiform apex; the capsules too are slightly different in outline, and the calyx lobes crowning the capsule of *W. gracilis* A. DC. are erect.

Wahlenbergia gracilis A. DC. Monog. Campan. 142. 1830; F. v. Muell. Pap. Pl. **2:** 11. 1885; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 593. 1900; White & Francis, Proc. Roy. Soc. Queensl. **38:** 260. 1927.

NETHERLANDS NEW GUINEA: Balim River, *Brass 11627,* December 1938, alt. 1600 m., plentiful on grassy deforested slopes. BRITISH NEW GUINEA: Central Division, Wharton Range, Murray Pass, *Brass 4640,* June-September 1933, alt. 2840 m., sporadic on grasslands.

We believe these collections represent *Wahlenbergia gracilis* A. DC. in the wider sense. They appear to be more like the Australian material passing as *W. gracilis* A. DC. than the Asiatic material labelled *W. marginata* A. DC. It is to be noted, however, that there has been a tendency to regard the two as the same species, although specialists working on the group state very definitely that the Australian material is different from the Asiatic. Nannfeldt, Act. Hort. Gothob. **5:** 32. 1929 (Campanulaceae in H. Smith, Pl. Sinenses) indicated that N. E. Brown, Gard. Chron. **54:** 316. 1913, discussed and defined *Wahlenbergia gracilis,* attributing the combination to Schrader who did not complete it, and pointing out that *W. gracilis* A. DC. is a mixture of at least a half dozen perfectly distinct species; also that the entities cannot be untangled without considerable study of the types.

Pentaphragma Wallich

Pentaphragma macrophyllum Oliver, Jour. Linn. Soc. Bot. **15:** 29. 1875; F. v. Muell. Pap. Pl. **1:** 28. 1876; Valeton, Bull. Dept. Agric. Néerl. Ind. **10:** 68. 1907; Pulle, Nov. Guin. Bot. **8:** 407. 1910, l. c. 691. 1912; Lam, Nat. Tijdschr. Nederl.-Ind. **88:** 213, 218. 1928.

NETHERLANDS NEW GUINEA: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass 12904,* alt. 1200 m., in sheltered gully in rain-forest; 4 km. southwest of Bernhard Camp, Idenburg River, *Brass 13275,* alt. 850 m., occasional on shady banks of rain-forest streams. BRITISH NEW GUINEA: Fly River, 528 mile Camp, *Brass 6622,* May 1936, alt. 80 m., casual in gullies of forest (a striking fleshy unbranched shrub ± 1 m. high; leaves smooth and shining, nerves deeply impressed above, prominent below; sepals greenish white; petals yellow; fleshy white fruit containing very small brown seeds).

The collections from Netherlands New Guinea agree closely with the original description. These have a practically glabrous flower, somewhat pubescent at the base and also on the subtending bracts and along the axis of the inflorescence. The lower surface of the leaves is pubescent chiefly along the nerves. In the Fly River material, the calyx-tube is pubescent outside even when mature, the axis of the inflorescence and the floral bracts are densely so, and the entire lower surface of the leaves is sparsely pubescent. Possibly further collections will reveal other differences.

Lobelia Linnaeus

Lobelia brachyantha sp. nov.

Herba prostrata paullo ramosa, consperse pilosa, trichomatibus simplicibus pluricellularibus; caulibus gracillimis; foliis parvis, late reniformi-orbicularibus, 2.5–5 mm. longis, 3–7 mm. latis, petiolatis, petiolo ± 2 mm. longo; margine undulato-dentatis, dentibus mucronulatis, supra consperse pilosis, subtus glabris; floribus axillaribus; pedunculis 4–5 mm. longis; hypanthio brevissimo, calycis lobis 2–2.5 mm. longis, lineari-lanceolatis obtusiusculis, margine utroque prope medio lobulum unum gerentibus; corolla purpurea, oblique subcampanulata, 3 mm. longa, tubo brevi intus maculato atque minute piloso, lobis extus pilosis, 3 anticis ovatis, 2 posticis paullo oblique lanceolatis; staminibus connatis, fere 3 mm. longis, filamentis glabris, antherarum tubo extus postico parce glanduloso, antheris 2 inferioribus minoribus apice setigeris, 3 superioribus apice nudis; capsulis vix 3 mm. longis, bivalvis; seminibus compressis ovoideis.

Netherlands New Guinea: Bele River, 18 km. northeast of Lake Habbema, *Brass 11570* (type), November 1938, alt. 2350 m., creeping on bare rock on a sparsely vegetated limestone precipice (flowers a very dark purple).

Lobelia brachyantha is a very small species with a *Pratia*-like habit belonging to the section *Hemipogon*. It differs from the description of *L. arfakensis* Gibbs in the very shallowly sinuate-dentate leaf-margins, the much smaller flowers and capsules, the very short hypanthium, and the minutely lobed or toothed calyx-lobes. The hairs of the pubescence are distinctly several-celled.

Lobelia microcarpa C. B. Clarke in Hook. f. Fl. Brit. Ind. **3**: 424. 1881, *vel aff.*

British New Guinea: Oriomo River, Wuroi, *Brass 5737*, January-March 1934, alt. 10–30 m., common throughout the savannahs (fleshy

ascending herb with small blue flowers); Lake Daviumbu, Middle Fly River, *Brass 7839*, plentiful on wet savannahs and open grass plains (flowers bright blue).

This plant (from 10–50 cm. in height) is much larger than that (7–13 cm.) which was the basis of the original description, yet the characters are similar: the lower leaves are lanceolate-ovate, crenulate-dentate, the upper are linear and bract-like. The seeds are distinctly trigonous. Unfortunately, we have no material for comparison. It is very much like some collections from Indo-China and China at present passing under various names, including material named by F. E. Wimmer as a variety of *L. alsinoides* Lam. and described by Danguy as *L. chinensis* Lour. var. *cantonensis* Wimm.

Lobelia zeylanica L. Sp. Pl. 932. 1753; G. Don, Gen. Syst. **3**: 709. 1834.

Lobelia succulenta Blume, Bijdr. 728. 1826; Lam, Nat. Tijdschr. Nederl. Ind. **89**: 315, 317. 1929.

Lobelia affinis Wall. List no. 1311. 1829, *nomen nudum;* G. Don, Gen. Syst. **3**: 709. 1834; S. Moore, Trans. Linn. Soc. Bot. II. **9**: 88. 1916; Diels, Bot. Jahrb. **55**: 122. 1917.

Lobelia barbata Warb. Bot. Jahrb. **13**: 444. 1891; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 593. 1900.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, *Brass 13253*, March 1939, alt. 850 m., rain-forest, common on open flood banks of river; Bernhard Camp, Idenburg River, *Brass 13965*, April 1939, alt. 55 m., on silt beds in a rain-forest stream (flowers violet). NORTHEASTERN NEW GUINEA: in open thickets, *Schlechter 18258*, September 1908, alt. 600 m.

Two factors probably have contributed to the confusion associated with the interpretation of *Lobelia zeylanica* L. Linnaeus derived his specific name from *Campanula ceylanica, senecionis folio, flore purpureo* Seba, Thes. **1**: 37. *t. 22, f. 12.* 1734, yet, at the same time, adding a question mark to the reference; however, his description was based wholly on a plant collected by Osbeck, near Canton, China, and this, as described, represents a species totally different from the form Seba illustrated. The Osbeck specimen is unquestionably the type of *L. zeylanica* L. We have examined a number of collections from southern China which agree well with the description of Linnaeus' species, and some of these have been so named by F. E. Wimmer. In the herbarium of the New York Botanical Garden is a specimen named in Blume's handwriting as *L. succulenta* Bl., thus being apparently an isotype. It is a good match for the Chinese material of *L. zeylanica* L., and also for the Indian material of *L. affinis* Wall. It should be noted, however,

that De Candolle, Prodr. **7**: 373. 1839, placed *L. succulenta* Bl. in §2, characterized thus, "Antherae 2 solum inferiores apice barbatae vel setis terminatae," and in his specific description says "Antherae superiores glabrae"; his authority for this is "(v. in h. mus. Par. a cl. Blum. miss.)." Hence, it would seem either that Blume distributed a mixed collection or that De Candolle erred in his observations. We have at hand collections of this species from China, India, Sumatra, Java, and New Guinea.

A collection from Java labeled in Blume's handwriting as *Lobelia javensis* Zipp. is a distinctly different species.

Phyllocharis Diels

Phyllocharis subcordata sp. nov.

Herba basi radicans; caulibus glabris; foliis 1–1.5 cm. petiolatis, tenuiter membranaceis, glabris vel subtus in nervis puberulis, anguste ovatis, 1.5–3.5 cm. longis, 1.2–2 cm. latis, apice acutiusculis, basi subcordatis vel truncato-subcordatis saepe paullo inaequilateralibus, margine crenato-dentatis, dentibus mucronatis; floribus pedunculatis; pedunculo 5–6 mm. longo; calycis tubo 1–2 mm. longo, glabro, lobis linearibus, 2–3 mm. longis; corollae tubo brevissimo, lobis 2 posticis 8 mm. longis, 0.5 mm. latis, quam labio antico subduplo longioribus, glabris, lobis 3 anticis 3 mm. longis supra medium connatis, intus papillosis; seminibus minute verruculosis.

Northeastern New Guinea: Morobe District, Yoangen, *Clemens 3426* (type), June 1936, alt. ± 1200 m., on wet bank with *Elatostemma* (flowers yellow); Malalo Mission, *Clemens 4404A*, December 1936, alt. ± 750 m.

In the crenate-dentate leaf-margin and the inner papillose surface of the anterior lip of the corolla, this species approaches *Phyllocharis Schlechteri* Diels; in the practically glabrous flower, the much longer posterior lobes of the corolla and the verruculose seeds there is a likeness to *P. oblongifolia* Diels. *Phyllocharis subcordata* differs from both species in the subcordate or truncate and very shallowly lobed leaf-base.

GOODENIACEAE

Velleia Smith

Velleia spathulata R. Br. Prodr. 580. 1810; F. M. Bail. Queensl. Fl. **3**: 894. 1900; Krause, Pflanzenr. **54**(IV.277): 29. 1912.

British New Guinea: Western Division, Oriomo River, Dagwa,

Brass 5931, February-March 1934, alt. 40 m., common on damp slopes of open ridges (ascending panicles of pale yellow flowers); Wassi Kussa River, Tarara, *Brass 8385,* December 1936, savannah forest, common in poorly drained gray soils (flowers yellow).

Apparently these are the first collections of this genus outside of Australia. The first collection cited was identified by Mr. C. T. White with the comment that it was a good match for the Australian plant.

Calogyne R. Brown

Calogyne pilosa R. Br. Prodr. 579. 1810; F. M. Bail. Queensl. Fl. **3:** 905. 1900; Merr. Govt. Lab. Publ. **35:** 68. 1905, Enum. Philip. Fl. Pl. **3:** 589. 1923; Krause, Pflanzenr. **54**(IV.277): 95. 1912.

BRITISH NEW GUINEA: Western Division, Oriomo River, Dagwa, *Brass 5995,* February-March 1934, alt. 40 m., common amongst grass on a savannah forest ridge (flowers brownish purple).

The species has been found previously in China, the Philippines, and Australia.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

BRASSIANTHA, A NEW GENUS OF HIPPOCRATEACEAE FROM NEW GUINEA*

A. C. Smith and I. W. Bailey

With one plate

A species occurring in the New Guinea collections of both Brass and Clemens was first called to the attention of the authors by Drs. E. D. Merrill and L. M. Perry, who, in their studies of the Celastraceae of these collections, came to the conclusion that the plant more probably belonged in the Hippocrateaceae than in the Celastraceae. Further study verified the conclusion that the species is a member of the Hippocrateaceae, although in many respects it is unique and far from typical of the family as previously understood. We propose to designate this plant as the type-species of a new genus, *Brassiantha,* so named in honor of Mr. L. J. Brass, whose extensive collections in New Guinea as a member of the Richard Archbold Expeditions have greatly enriched our botanical knowledge of the region. All material cited in this paper is deposited in the herbarium of the Arnold Arboretum. The first author has drawn up the formal description and has compared the plant with other genera of the Hippocrateaceae, while the second author has contributed the comments on the anatomical relationships of the new genus.

BRASSIANTHA A. C. Smith, gen. nov.

Arbores parvae, ramis ramulisque gracilibus alternatis, foliis alternatis petiolatis, laminis chartaceis vel papyraceis; inflorescentiis ex axillis foliorum interdum delapsorum orientibus paniculatis vel pseudocymosis, ramulis paucis alternatis vel suboppositis bracteis parvis subtentis; floribus parvis in cymulas aggregatis vel apicem inflorescentiarum versus solitariis bracteolis inconspicuis pluribus suffultis; pedicellis gracilibus basim versus inconspicue articulatis; calyce cupuliformi, sepalis 5 anguste imbricatis; petalis 5 sub anthesi erecto-patentibus; disco carnoso annulari-pulvinato discontinuo (segmentis 5 oblongis distinctis sed contiguis composito); staminibus 5 erectis intra discum dispositis et segmentis disci alternatis, filamentis obscure ligulatis apice antheris

*Botanical Results of the Richard Archbold Expeditions.

articulatis, antheris extrorsis, connectivo conspicuo glanduloso, loculis 2 obliquis subapicalibus rimis distinctis (saepe contiguis vel subconfluentibus) dehiscentibus; ovario truncato-conico apice leviter depresso et stigmatibus inconspicuis radiatim signato, stylo nullo, loculis 5 staminibus alternatis, ovulis in quoque loculo 2–5 superpositis vel biseriatis (superioribus interdum singulis); inflorescentiis fructiferis valde incrassatis, fructibus paucis capsularibus subglobosis suturis loculicide dehiscentibus, pericarpio coriaceo, dissepimentis subcoriaceis; seminibus 2–4(–5) (raro abortu 1) ellipsoideo-oblongis suberectis superpositis vel irregulariter imbricatis in pulpo sparso ut videtur nidulantibus, testa membranacea, cotyledonibus crassis ut videtur confluentibus.

Brassiantha pentamera A. C. Smith, sp. nov.

Arbor gracilis ad 10 m. alta ubique praeter flores interdum minutissime puberulos glabra, ramulis subteretibus fusco-cinereis; petiolis gracilibus leviter canaliculatis 3–10 mm. longis basi saepe paullo incrassatis; laminis siccitate fuscis vel olivaceis oblongo-ellipticis, (4–)5–12 cm. longis, (1.3–)2–4(–5) cm. latis, basi acutis et in petiolum decurrentibus, apice obtuse cuspidatis vel breviter acuminatis (acumine ad 6 mm. longo), margine integris, subtus saepe pallidioribus, costa supra leviter elevata subtus subprominente, nervis secundariis utrinsecus 5–9 brevibus patentibus marginem versus arcuatis et inconspicue anastomosantibus supra subplanis vel minute prominulis subtus manifeste prominulis, rete venularum immerso vel subtus leviter prominulo; inflorescentiis 5–18 mm. longis 4–15-floris, pedunculo gracili ad 8 mm. longo vel nullo (ramulis in axillis foliorum paucis), ramulis brevibus, bracteis connatis vel singulis papyraceis oblongo-deltoideis 0.8–1.4 mm. longis acutis margine integris vel undulatis; bracteolis basi pedicellorum plerumque 4–6 inconspicuis laxe imbricatis ut bracteis similibus sed 0.4–1 mm. longis; pedicellis sub anthesi 2.5–11 mm. longis apicem versus inconspicue incrassatis; floribus sub anthesi 2.5–3.5 mm. diametro; calyce obscure et parce albo-peltato-squamuloso, sepalis tenuiter carnosis late deltoideo-ovatis, circiter 0.7 mm. longis, 0.8–1.3 mm. latis, obtusis, margine subintegris et obscure scariosis; petalis submembranaceis oblongis, 1.7–2.5 mm. longis, 1–1.3 mm. latis, subacutis integris glabris vel utrinque obscure puberulis; disco sub anthesi circiter 1.5 mm. diametro et 0.4 mm. alto basim versus tenuiore; filamentis circiter 0.5 mm. longis, connectivo transverse ellipsoideo circiter 0.3 mm. longo et 0.6 mm. lato, loculis 0.4–0.5 mm. longis; ovario carnoso sub anthesi 0.5–0.9 mm. longo et lato; fructus pedicellis ad 12 mm. longis et apicem versus 3–4 mm. diametro; fructibus ad 3 cm. diametro leviter 5-sulcatis,

pericarpio 2–4 mm. crasso utrinque levi, seminibus leviter falcatis circiter 12 mm. longis, 7 mm. latis, et 5 mm. crassis, uno latere rapha suberosa inconspicua carinatis.

NETHERLANDS NEW GUINEA: Hollandia and vicinity, alt. 20–50 m., *Brass 8889* (tree 2 m. high, in rain-forest undergrowth; flowers red), *Brass 8954, 8956* (TYPE), July 7, 1938 (bushy trees to 10 m. high, plentiful in secondary rain-forest on steep slopes; flowers red; fruits and seeds red). NORTHEASTERN NEW GUINEA: Morobe District, Ogeramnang, alt. about 1800 m., *Clemens 5082* (small tree, on forested hill above water-supply, the trunk about 7 cm. diam.; buds green, the flowers purplish red), *Clemens 5413*.

Of the cited material, the Brass specimens bear excellent flowers, *8954* and *8956* being accompanied by abundant mature fruits; both Clemens specimens have buds or very young opened flowers, *5413* having also a few fruits. In all respects the five specimens appear essentially identical. The fact that the plant is found near sea-level and again at 1800 meters may indicate that it is actually not uncommon; it seems likely that other collectors have obtained it, and one may expect to find additional specimens among those not yet referred to families.

Although *Brassiantha pentamera* bears little superficial resemblance to the members of the Hippocrateaceae, one observes, upon analysis of each character, that there is no reason to exclude it. Following is a discussion of these characters and remarks on the relationship of the new genus.

Transverse sections of the branchlets of *Brassiantha* are characterized by having zones or bands of septate fibers in the secondary xylem. Such a tendency for the replacement of banded apotracheal parenchyma by banded septate fibers occurs in *Maytenus* of the Celastraceae and in *Salacia* (and other related genera having drupaceous fruits) in the Hippocrateaceae. That *Brassiantha* belongs in one of these families is indicated by its unilacunar nodes and by an abundance of elastic material, viz. caoutchouc, in the leaves. Furthermore, the general histological and anatomical features of the pith, xylem, cortex, and leaf are indicative of such a relationship.

It should be emphasized in this connection, however, that there are conspicuous trends of structural specialization in the Hippocrateaceae which are closely correlated with transitional stages of the acquisition of a climbing habit of growth. Both the inner and the outer secondary xylem of non-scandent representatives of *Salacia* are of "normal" structure, whereas in subscandent or scandent species the first-formed

secondary xylem is of this type but the later-formed wood exhibits a more or less abrupt transition to a large-vesselled "anomalous" type of structure. Therefore, in studying the relationships of *Brassiantha* it is essential to focus one's attention upon comparisons with non-scandent species or with the more normal first-formed secondary xylem of scandent ones.

The wood of available species of *Salacia* differs from that of the celastraceous genus *Maytenus* in having narrower rays which frequently are dominantly uniseriate and with an evident tendency to form some paratracheal parenchyma. The xylem of the young stems of *Brassiantha* has high-celled mostly uniseriate rays and little or no paratracheal parenchyma. Thus, in this respect, the genus appears at first sight to be somewhat intermediate in structure between *Salacia* and the celastraceous genus. Unfortunately, there is no later-formed xylem available for determining whether multiseriate rays are formed during the later stages of the ontogeny of the stems. Such retardations in the formation of multiseriate rays occur not infrequently in the young stems of celastraceous genera. Furthermore, many additional species of *Salacia* and *Maytenus* must be studied in order to determine the range of structural variability within these genera. Therefore, it is not possible at present to refer *Brassiantha* to the Hippocrateaceae rather than to the Celastraceae solely upon the basis of diagnostic features of the secondary xylem.

Alternate leaves are unusual in the Hippocrateaceae, but they occur in several species of *Salacia, Tontelea, Peritassa,* and perhaps elsewhere; subopposite, rather than strictly opposite, leaves are common. The characters of *Brassiantha* pertaining to the inflorescence, bracts, bracteoles, pedicellary articulation, sepals, and petals are not unusual for the Hippocrateaceae.

The disk in the Hippocrateaceae is annular and continuous in all genera except *Cheiloclinium,* where it is disjunct into small pockets each subtending a stamen (see A. C. Smith, Brittonia **3:** 525–550. *fig. 12.* 1940). In *Brassiantha* the disk is composed of five pulvinate glands which are contiguous at the ends to form a pseudocontinuous annular disk. Actually, this is not a continuous disk in the sense of other Hippocrateaceae, but it does not seem any more remarkable in its way than the disk of *Cheiloclinium.* As there is no doubt that the latter genus belongs in the family, one cannot exclude *Brassiantha* on the basis of its disk, which is, however, quite unique and certainly a character of generic value.

Throughout the Hippocrateaceae, stamens are three (sporadically two or four), except for two species of *Cheiloclinium* in which they are con-

sistently five. The presence of five stamens, therefore, cannot be used to exclude our plant. The stamens of *Brassiantha* are situated within the disk, which is normal for the family (but not for the Celastraceae), and they are opposite the breaks in the disk. This is quite the reverse of their position in *Cheiloclinium,* where they are opposite the centers of the portions of disjunct disk. The presence of swollen connectives has been occasionally noted in *Cheiloclinium* and *Peritassa,* but *Brassiantha* has them much more conspicuous; this, however, is hardly an excluding character. The locules and their dehiscence are normal for the family. The pollen of *Brassiantha* clearly falls within the range of structural variability of the Hippocrateaceae. In this connection, however, it is of interest to note that the pollen of the Celastraceae exhibits a similar range of variability in size, form, and structure as that of the Hippocrateaceae.

As to the ovary, the lack of a style is remarkable, occurring elsewhere in the Hippocrateaceae only in *Cheiloclinium.* In the latter genus the stigmas are sessile and radiating on the summit of the ovary but always obvious; in *Brassiantha* the stigmas are obscure, apparently reduced to minute radiating lines in the hollow of the ovary-summit. This apical hollow is not elsewhere found in the family. The arrangement of septae opposite the stamens is normal (in the species of *Cheiloclinium* with five stamens there are also five locules). Superposed ovules are common in the family, and their inner basal position is characteristic.

The fruit of *Brassiantha* is unique for the Hippocrateaceae. In other genera the fruit is either capsular and extended into three large wings or indehiscent and drupaceous. In *Brassiantha,* the fruit is capsular and dehiscent but not developed into wings, i.e. the vertical axis is not atrophied as it is in *Hippocratea* and allied genera. The loculicidal dehiscence of the fruit of *Brassiantha* is paralleled in the other dehiscent-fruited genera, in which each capsule dehisces down the middle. In a family with such great variation in its fruits, there is nothing fundamental about the fruit of *Brassiantha* which will serve to exclude the genus. The seed appears essentially similar to that of the drupaceous-fruited genera, with large cotyledons; in this case the cotyledons seem to be fused.

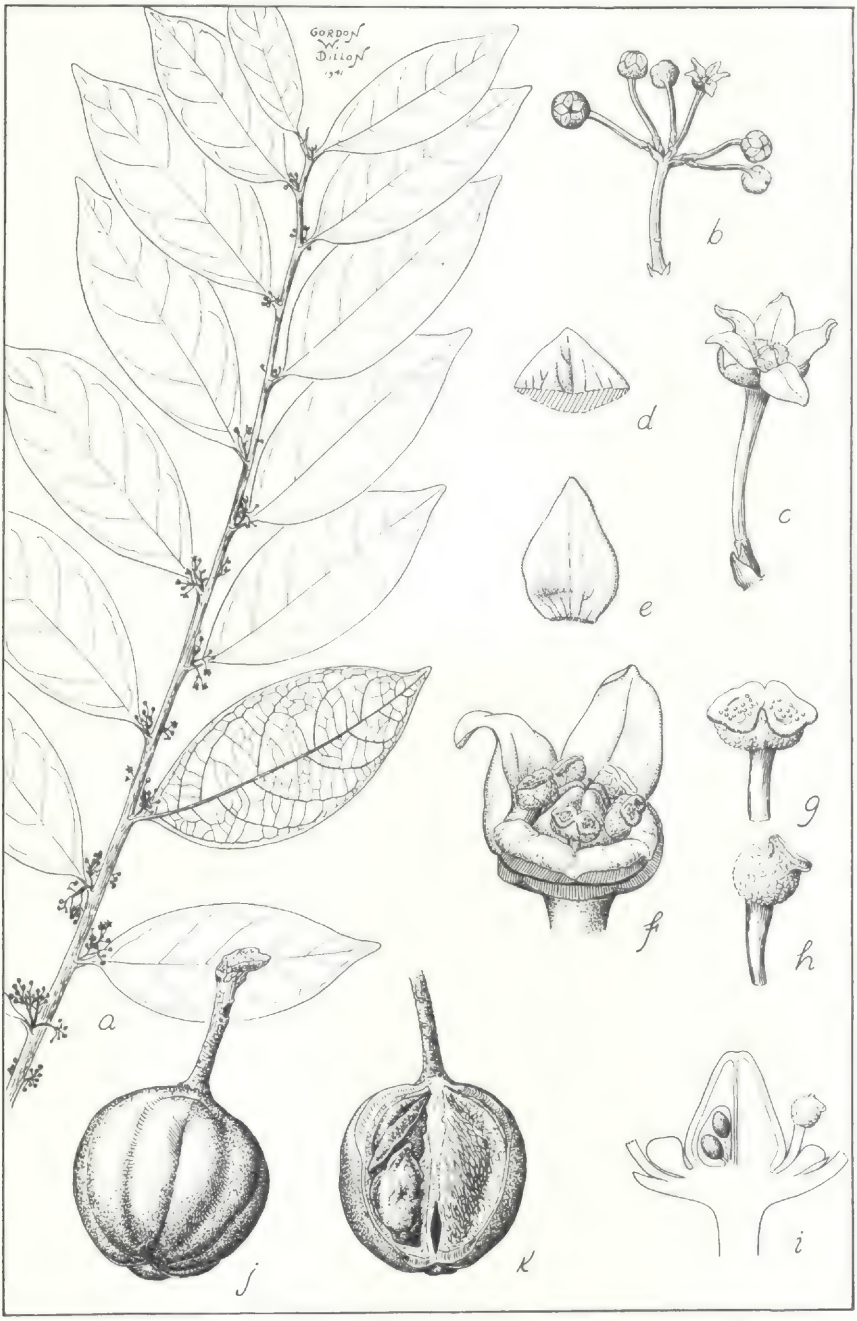
To summarize, the genus *Brassiantha* appears to have no characters which can be used to exclude it from the Hippocrateaceae. On the other hand, it is so distinct from known genera, in the characters of its disk, stamens, ovary, and fruit, as to make comparison superfluous. It appears to be rigidly excluded from the Celastraceae, as that family is at present constituted, by the position of the stamens within the disk.

This, indeed, may be the only fixed character by which the families Hippocrateaceae and Celastraceae may be separated. If so, one must consider the families quite artificial, especially since they exhibit parallel series of variations in characters pertaining to wood-anatomy and pollen-structure.

EXPLANATION OF PLATE

FIG. *a*. Flowering branchlet, × ½; *b*. Inflorescence, × 2; *c*. Flower, × 5; *d*. Sepal, × 10; *e*. Petal, × 10; *f*. Flower with sepals and three petals removed, × 15; *g*. Stamen, exterior view, × 30; *h*. Stamen, lateral view, × 30; *i*. Longitudinal section through flower, × 15; *j*. Fruit, × 1; *k*. Fruit with two carpels removed, × 1.

ARNOLD ARBORETUM AND BIOLOGICAL LABORATORIES,
HARVARD UNIVERSITY.



BRASSIANTHA PENTAMERA A. C. SMITH

STUDIES IN THE THEACEAE, VII
THE AMERICAN SPECIES OF THE GENUS CLEYERA

CLARENCE E. KOBUSKI

THE genus *Cleyera,* well known and generally accepted as a distinct genus of the Theaceae by students of the Asiatic flora, has been included under the genus *Eurya* by workers on the flora of tropical America. This is probably due to the fact that Szyszylowicz, in the first edition of Engler and Prantl's Natürliche Pflanzanfamilien, treated *Cleyera* as a section of *Eurya.* Included here also as a section was the American genus, *Freziera.* Urban in 1896 protested vigorously at this treatment (and rightly so), feeling that all three should be retained as distinct genera. However, Melchior, in the second edition of Engler and Prantl's work, followed the lead of Szyszylowicz, if perhaps a little less strongly, and raised the questionable sections of Szyszylowicz to subgenera.

The genus *Eurya* is confined to the eastern hemisphere and is characterized by dioecious flowers and by having the stamens uniseriate in multiples of five, with glabrous anthers. The pedicels are quite short (usually less than 5 mm.) and decidedly curved. The petals are joined for approximately one-third of their entire length.

Cleyera ranges through the tropics and subtropics of both hemispheres and can be distinguished from the genus *Eurya* by the hermaphroditic flowers and the uniseriate stamens, usually in multiples of five, often in odd numbers, with distinctly setose anthers. The pedicels are seldom less than 10 mm. long (often up to 20–25 mm.), sturdy and conspicuous. The petals are joined only lightly at the base.

Cleyera was first described by Thunberg in his Nov. Gen. **3:** 69. 1783 and was named in honor of the physician and botanist Andrew Cleyer, Dutch Director of Commerce during the years 1683–1688. Thunberg described a single species, *Cleyera japonica,* and based his description on plants growing near Nagasaki, Japan.

Unfortunately, this description was based upon two shrubs, as an examination of the type indicates. Nearly filling the sheet is an ample specimen of *Cleyera japonica,* while in the upper right corner is a fragment or near fragment of *Ternstroemia gymnanthera* (W. & A.) Sprague. Later, realizing the discrepancy mentioned above, Thunberg

came to the conclusion that *Cleyera* was congeneric with *Ternstroemia* and transferred his *Cleyera japonica* to *Ternstroemia* under the name *T. japonica.*

In 1841, Siebold & Zuccarini took up the original name *Cleyera.* They drew attention to the fact that Thunberg undoubtedly did have the two distinct elements at hand when he first described *Cleyera.* At the same time, however, they emended his description and pointed out that careful study showed that, regardless of what material Thunberg had, his actual generic description was based on the specimen of *Cleyera* and could refer only to *Cleyera.* True enough, in the specific description, the leaf arrangement refers to *T. japonica* (*T. gymnanthera* Sprague). However, this does not affect the status of the genus. They cleared up the whole matter and treated in detail both original elements under their respective genera and gave the specific epithet "*japonica*" to both. Recently Sprague, realizing that *T. japonica* could not be retained, made the combination *T. gymnanthera* (W. & A.) Sprague.

With Siebold and Zuccarini's work, confusion should have ended, because their treatment of the whole subject seems very clear and quite final. Sprague's treatment of the generic status of *Cleyera* in Jour. Bot. **61**: 17. 1923 did much to clear up the whole situation and probably directly or indirectly caused the name *Cleyera* to be placed on the list of "nomina conservanda" by the International Congress of 1935.

The generic name *Sakakia* is clearly a true synonym of *Cleyera.* This name was proposed by Nakai, who hoped to clear up the involved synonymy. Evidently unaware of or ignoring the action taken by the International Congress in the case of *Cleyera,* the Japanese botanists have all rallied to Nakai and wholeheartedly accepted the name *Sakakia.* Incidentally, this name would have been most fitting since *Cleyera japonica,* the type of the genus, is generally known throughout the Japanese Empire as "Sakaki." From ancient times the species has been known and revered. It grows wild in the mountainous districts and can be found planted around the homes and about Shinto shrines. It is sometimes called "Mijam Sakaki" meaning "God-of-the-high-mountains." "Tamakushige" a kind of wand, dedicated to the gods, has been made from this plant, explaining the name "Tree-of-God." According to Siebold and Zuccarini, the Buddhists revere the tree because their priests maintain it is a species close to the "Sara tree" under which the founder of their cult died.

Besides the type species itself, there are several varieties growing throughout Formosa, China, Tibet and India. Some of these have been

given specific status at times but are usually considered varieties. The species itself and all its varieties, with the exception of *Cleyera japonica* var. *lipingensis* (Hand.-Mazz.) Kobuski are entire-leaved. In the western hemisphere, all species except *C. albo-punctata*, *C. Ekmani* and *C. integrifolia* have crenulate or serrulate leaves.

Treatment of the Asiatic species was made by the writer in Jour. Arnold Arb. **18:** 118–129. 1937. The present paper is concerned only with the species of the western hemisphere. The specimens used in this study and cited in this current paper are from the herbaria of the Arnold Arboretum (AA); Gray Herbarium (G); Field Museum of Natural History (FM); Missouri Botanical Garden (MO); New York Botanical Garden (NY); and the United States National Museum (US).

Cleyera Thunberg, Nov. Gen. **3:** 69. 1783. — Siebold & Zuccarini, Fl. Jap. 153, t. 81. 1841. — Choisy in Mém. Soc. Phys. Hist. Nat. Genève, 1854, 14 (Mém. Ternstroem. 21). 1855. — Bentham & Hooker, Gen. Pl. **1:** 183. 1862. — Urban in Berichte Deutsch. Bot. Gesellsch. **14:** 49. 1893; in Bot. Jahrb. **21:** 537. 1893. — Sprague in Jour. Bot. **61:** 17, 83. 1923. — Internat. Rules Bot. Nomencl. ed. 3, 135. 1935. — Kobuski in Jour. Arnold Arb. **18:** 118–129. 1937.

Tristylium Turczaninow in Bull. Soc. Nat. Moscou, **31, 1:** 247. 1858.

Eurya § *Cleyera* Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III, Abt. **6:** 189. 1893.

Eurya subgen. *Cleyera* Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21:** 147. 1925.

Sakakia Nakai, Fl. Sylv. Kor. **17:** 77, t. 19. 1928.

Trees or shrubs. Leaves evergreen or deciduous, entire or serrulate. Flowers hermaphroditic, solitary or in fascicles in the leaf-axils. Pedicels usually 1 cm. or more in length, thickened at the apex, bibracteolate, the bracteoles minute, subopposite or alternate near apex of pedicel. Sepals 5, imbricate, unequal, the outer sepals smaller, ciliolate. Petals 5, imbricate, connate at the very base. Stamens about 25; anthers setose, biloculate with longitudinal openings. Ovary usually glabrous, 2–3-celled, with many ovules; style elongate, 3- or 4-fid at the apex. Fruit indehiscent, baccate, spherical or ovoid, many-seeded; seeds with thin endosperm and curved embryo.

TYPE SPECIES: *Cleyera japonica* Thunberg, emend. Siebold & Zuccarini.

KEY TO THE SPECIES

A. Leaves entire.

B. Pedicels up to 25 mm. long with persistent bracteoles 4–5 mm. long; sepals up to 8–9 mm. wide; stamens with filaments 5–9 mm. long, the anthers 2.5 mm. long. (Cuba, Porto Rico) ..... 1. *C. albo-punctata.*

BB. Pedicels 10–14 mm. long (rarely up to 20 mm. long in *C. integrifolia*) with bracteoles, when present, not over 2 mm. long; sepals 4 mm. wide or less; stamens with filaments not over 3.8 mm. long, the anthers not over 1.2 mm. long.

C. Flowers large; petals 7–9 mm. long, 6.0–6.5 mm. wide; sepals always glabrous; leaves rounded or emarginate at apex. (Cuba) ..... 2. *C. Ekmani.*

CC. Flowers medium-sized; petals not over 5 mm. long; sepals usually pubescent, at least at first; leaves acuminate at apex. (Mexico) ..... 3. *C. integrifolia.*

AA. Leaves crenate or serrulate.

D. Leaves membranaceous.

E. Leaves oblique, elliptic, rounded at base, the lateral veins numerous and evident on both surfaces. (Dominican Republic) ..... 4. *C. Bolleana.*

EE. Leaves symmetrical, obovate, cuneate at base, the lateral veins 8–10, inconspicuous on both surfaces. (Chiapas, Mexico) ..... 5. *C. Matudai.*

DD. Leaves coriaceous.

F. Leaves over 5 cm. long, obtuse or acuminate at apex.

G. Leaves, branchlets, pedicels and calyx definitely pubescent.

H. Inflorescence 9–10-flowered; calyx-lobes acute, connivent. (Mexico) ..... 6. *C. cernua.*

HH. Inflorescence 1–2-flowered; calyx-lobes obtuse, not connivent.

I. Leaves revolute, oblanceolate, 1.5–2.5 cm. wide, obtuse or rounded at apex; styles 3–4-parted. (Guatemala) ..... 7. *C. revoluta.*

II. Leaves not revolute, obovate, 3–5 cm. wide, obtusely acuminate at apex; styles always 3-parted. (Guatemalan-Mexican border) ..... 8. *C. tacanensis.*

GG. Young parts and branchlets glabrous or occasionally lightly pubescent, quickly glabrescent.

J. Ovary hirsute near apex; style small, 1.25–1.50 mm. long; calyx and pedicel densely hirsute. (Mexico) ..... 9. *C. serrulata.*

JJ. Ovary glabrous; styles ca. 3 mm. (2–3 mm. in *C. theaeoides*), calyx and pedicel glabrous or glabrescent.

K. Pedicels short (5–7 mm. long); petals white. (Guatemala, Mexico). .....10. *C. Skutchii.*

KK. Pedicels 10–14 mm. long; petals yellow, greenish yellow or greenish white.

L. Leaves 3–5 cm. long, sharply serrate. (Costa Rica). .....11. *C. costaricensis.*

LL. Leaves 4–8 cm. long, crenate or crenulate.

M. Calyx pubescent; petals ca. 6 mm. long.

N. Shrub; petiole 4–7 mm. long; lateral veins 7–10. (Cuba). .. ..12. *C. nimanimae.*

NN. Tree; petioles 7–10 mm. long; lateral veins ca. 12. (Panama, Costa Rica). 13. *C. panamensis.*

MM. Calyx glabrous; petals ca. 10 mm. long. (Jamaica)...14. *C. theaeoides.*

FF. Leaves less than 4 cm. long, rounded or emarginate at apex.

O. Leaves less than 2 cm. long, less than 1 cm. wide, appressed pilose beneath, the petioles 1–2 mm. long; internodes 2–3 mm. long. (Haiti). ..15. *C. vaccinioides.*

OO. Leaves 2.0–3.3 cm. long, 1.5–1.9(2.2) cm. wide, glabrous beneath, the petioles 3–5 mm. long; internodes 5–6 mm. long. (Haiti). .....16. *C. ternstroemioides.*

1. **Cleyera albo-punctata** (Grisebach) Krug & Urban in Bot. Jahrb. **21**: 537. 1896.

Ternstroemia albo-punctata Grisebach, Cat. Pl. Cuba, 36. 1866.
Eurya albo-punctata (Grisebach) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 147. 1925.
Erotcum albo-punctatum (Grisebach) Britton in Britton & Wilson, Sci. Survey Porto Rico & Virgin Isl. **5**: 582. 1924.

DISTRIBUTION: West Indies (Cuba and Porto Rico).

CUBA. Oriente: Sierra Nipe, near Woodfred, edge of pines, alt. ca. 550 m., *J. A. Shafer 3050, 3455* (NY), *3148* (NY, G), Dec. 1909–Jan. 1910 (shrub or small tree 15–20 ft. with cream colored flowers). — Camp La Gloria, south of Sierra Moa, *J. A. Shafer 8115, 8183, 8297* (NY), Dec. 1910–Jan. 1911 (shrub or tree 12–20 ft.; flowers pendent, creamy white; fruit long-pedicelled, red). — Loma del Gato and vicinity of Cobre range of the Sierra Maestra, alt. 850 m., *Fre. Leon, Clement & M. Roca 10006* (NY), July 11–Aug. 14, 1921 (tree 10 m. or more tall; flowers yellow).

PORTO RICO. Humacao: Sierra de Naguabo, Monte el Duque, mountain forest, *J. A. Shafer 2242* (NY), Mar. 8, 1914. — Same locality, Rio Prieto and adjacent hills, thickets at top of peak, alt. 1000 m., *J. A. Shafer 3643* (FM, MO, NY), Aug. 1914 (scrubby tree, 10 ft. with white flowers). — Same locality, thickets at summit of El Duque, alt. 750–1080 m., *J. A. Shafer 3659* (NY), Aug. 13, 1914 (straggling tree, 8 ft.). — Rio la Mina, Rio Piedras, *C. L. Horn 49* (NY), April 1934 (tree 50 ft., short trunk with large, long, spreading branches; bark smooth brown; flowers greenish white). Mayaguez: in forest near Maricao, *P. Sintenis 193* (G, MO, NY) Dec. 10, 1884. Luquillo: Sierra de Luquillo, in sylvis montis Yunque, *Sintenis 1362* (G), July 14, 1885.

This species is easily distinguished by its large flowers (an inch or more across), the petals of which are strikingly pubescent along the medial strip on the dorsal surface. Persistent, subopposite bracteoles, 4–5 mm. long and wide at the apex of the smooth but rugged pedicels are other characters of note. The species is glabrous except for the individual terminal buds.

The leaves are thick-coriaceous, obovate to obovate-elliptic, rotund or occasionally emarginate at the apex, 5–11 cm. long and 2.0–5.5 cm. wide with the midrib deeply impressed on the upper surface. The under surface is much lighter in shade, the margin revolute, entire or very slightly serrate.

The flowers are solitary or occasionally in two's in the axils; the pedicels are sturdy, 1.0–2.5 cm. long, thickening toward the calyx, up to 2.5 mm. diam. at the point of juncture. The persistent bracteoles are larger than the calyx-lobes of the majority of species in the genus, ca. 4–5 mm. long and 4 mm. broad, deltoid or subrotund, apiculate at the apex. The calyx is typical of the genus, 5–6 mm. long and up to 8 mm. wide, especially leathery, obtuse or subrotund at the apex, the margin scarious. The petals are larger than those of most species (up to 12 mm. long and 7–10 mm. wide) with a scarious margin up to 2.5 mm. wide; the dorsal surface has a strip of dense shining pubescence.

The stamens, about 35 in number, have long filaments (5–9 mm.) and short anthers (ca. 2.5 mm.) which vary in the amount of pubescence. The ovary is glabrous and the style is three-parted for only a short distance from the apex.

The Porto Rican material usually has shorter pedicels and generally smaller flowers than the Cuban specimens.

Here might possibly be cited *Fuertes 1054* from Santo Domingo. The leaves are smaller, 2.5–5.0 cm. long, acute and mucronulate at the

apex. The flowers, as well, are smaller; the petals only sparingly pubescent. Also, *Fr. Leon 12246* from Cuba probably represents only a slight variation and should be cited here. The young branchlets and the under surface of the younger leaves are puberulent.

2. **Cleyera Ekmani** (O. C. Schmidt), comb. nov.

Eurya Ekmani O. C. Schmidt in Rep. Spec. Nov. **22**: 97. 1925.
Freziera Ekmani (O. C. Schmidt) Kobuski in Ann. Missouri Bot. Gard. **25**: 354. 1938.

DISTRIBUTION: West Indies (Cuba).

CUBA: Prov. Oriente, Sierra Maestra, Arroya Jiménez, alt. 600–900 m., *E. L. Ekman 14792* (paratype of *Eurya Ekmani*, NY), Aug. 9, 1922 (tree with white flowers).

Cleyera Ekmani is glabrous except for the leaf-buds and very young branchlets; shortly these both become glabrous. The leaves are glabrous, coriaceous, oblong-obovate or oblong-elliptic, 4–6 cm. long and 1.3–2.0 cm. wide, obtuse at the apex, cuneate at the base, entire or slightly denticulate at the apex, light green on the upper surface, brownish below (exsicc.). The petiole measures 3–4 mm. in length.

The flowers are found singly or in two in the axils, supported by glabrous pedicels 10–14 mm. long. The bracteoles (ca. 1 mm. long and broad) are suborbicular, ciliolate at the margin. The sepals are also suborbicular, unequal, ± 4 mm. long and wide, and ciliolate at the margin. The petals (fide O. C. Schmidt) are 7–9 mm. long, 6.0–6.5 mm. wide, pubescent up the middle of the dorsal surface. The stamens (fide O. C. Schmidt) ca. 25, the filaments 3.8 mm. long, the anthers elliptic, ± 1.2 mm. long, (pilose?). The ovary (fide Schmidt) subglobose, 3-celled, each cell containing approximately 25 ovules, with a style ca. 2.2 mm. long, three-parted.

Cleyera albo-punctata (Grisebach) Krug & Urban is the closest ally but can be easily separated by its much larger flowers (an inch or more across), the larger bracteoles (4–5 mm. long and wide), the sturdy pedicels (up to 2.5 cm. long), the larger calyx-lobes (5–6 mm. long and up to 8 mm. wide), the long filaments (up to 9 mm.), and the larger leaves (5–11 cm. × 2.0–5.5 cm.).

3. **Cleyera integrifolia** (Bentham) Choisy in Mém. Soc. Phys. Hist. Genève **14**: 110. 1855. — Hemsley, Biol. Centr.-Amer. **1**: 93. 1879. — Urban in Bot. Jahrb. **21**: 539. 1896.

Freziera integrifolia Bentham, Pl. Hartweg. 6. 1839.
Cleyera syphilitica Choisy in Mém. Soc. Phys. Hist. Genève **14**: 110. 1855. — Urban in Bot. Jahrb. **21**: 259. 1896.
Ternstroemia syphilitica Pavon ex Choisy, loc. cit. in synon.

Eurya integrifolia (Bentham) Blume, Mus. Bot. Lugd.-Bat. **2**: 105. 1856. — Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior, op. cit. ed. 2, **21**: 147. 1925.

Tristylium mexicanum Turczaninow in Bull. Soc. Nat. Moscou, **31, 1**: 248. 1858.

Cleyera mexicana (Turcz.) Planchon ex Hemsley, Biol. Centr.-Amer. **1**: 93. 1879.

Eurya syphilitica (Choisy) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 189. 1893. — Melchior, op. cit. ed. 2, **21**: 147. 1925. — Bullock in Kew Bull. Misc. Inform. **1936**: 391. 1936.

Eurya mexicana (Turcz.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Standley in Contrib. U. S. Nat. Herb. **23, 3**: 823. 1923. — Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 147. 1925.

Eurya Benthamiana Bullock in Kew Bull. Misc. Inform. **1936**: 391. 1936.

Freziera mexicana (Turcz.) Kobuski in Ann. Missouri Bot. Gard. **25**: 355. 1938.

DISTRIBUTION: Mexico (Jalisco, Michoacan, Mexico and Guerrero).

MEXICO. Jalisco: Bolaños, among pines, *T. Hartweg 18* (isotype of *Freziera integrifolia,* FM, G, NY), 1837 (shrub 8–10 ft.). Guerrero: Petlacala, north of Mine Santa Elena, streamside, alt. 1880 m., *Y. Mexia 9041* (NY), Dec. 27, 1937 (common tree 9 m. high with red fruit). — Same general locality, oak and pine forest, alt. 2750 m., *G. B. Hinton 15402* (AA), Dec. 30, 1939 (tree 10 m. high with dull white flowers). Mexico: Temascaltepec, *G. B. Hinton 319* (AA), *1099* (FM), *3835* (AA), *3886* (AA, FM), *7192* (AA), *7227* (AA, NY), *7704* (FM, NY), *7990* (AA, FM, US), 1932–1939. Michoacan: vicinity of Morelia, alt. 2100–2400 m., *Bro. G. Arsène 5371, 5663, 8461, 8474* (US). — Mountains above Cuernavaca, *C. G. Pringle 6957* (AA, FM, G, MO, NY, US), Aug. 9, 1898; Zitacuaro, deforested hillsides, rocky soil, alt. 2380 m., *G. B. Hinton 11950* (AA), June 10, 1938 (tree 15 m., flowers yellow-white); Barroloso, oak forest, alt. 2300–2600 m., *G. B. Hinton 15085* (G), *15098* (G), Aug. 9–10, 1939 (flowers wax white); Barroloso, alt. 2300 m. *G. B. Hinton 15374* (G), Oct. 22, 1939 (tree 8 m.). Without locality,? *Sessé & Mociño s. n.* (type of *Freziera syphilitica* Choisy, Genève *23952;* photo FM).

In the past, *Cleyera integrifolia* has been separated from *C. syphilitica* by its sericeous calyx, shorter pedicels and smaller leaves. Standley, in 1923, joined these two species under *Eurya mexicana.* Careful study of considerable material reveals that, although this species varies widely in all these characters, it cannot be separated clearly into two entities. The calyx, in the type, is glabrescent, generally appears pubescent to a more or less degree and is extremely sericeous. However, variation can

be found grading from nearly glabrous material (*Hinton 3835, 7227, 7704*) to the extreme pubescence in the type. In all cases, except *Hinton 15085*, the anthers possess a few hairs. Also the pedicels vary in length. *Hinton 15374*, from general appearances, should meet the requirements of *C. syphilitica* nicely. The calyx-lobes appear glabrous, except at the apex, and the peduncles are nearly 20 mm. long. However, the leaves measure only 8.0 × 3.7 cm. In the type of *C. syphilitica* the pedicels are ca. 20 mm. long and the leaves ca. 9.5 cm. long. These measurements were taken from a photograph. One can only assume that the calyx is glabrescent. *Hinton 15098* has a pubescent calyx, leaves measuring 7 × 4 cm., but peduncles up to 17 mm. long. *Hinton 7704* has a nearly glabrous calyx but the peduncles are only 5–9 mm. long and the leaves measure only ca. 8.0 × 2.5 cm. *Hinton 15402* has a pubescent calyx, peduncles 5–10 mm. long but leaves measuring up to 11 cm. long, exceeding the type of *C. syphilitica* in the last character.

4. **Cleyera Bolleana** (O. C. Schmidt) comb. nov.

Eurya Bolleana O. C. Schmidt in Rep. Spec. Nov. **33**: 177. 1933.
Freziera Bolleana (O. C. Schmidt) Kobuski in Ann. Missouri Bot. Gard. **25**: 354. 1938.

DISTRIBUTION: West Indies (Santo Domingo).

The distinguishing characters of this species are the membranaceous, oblique, elliptic leaves, 5.0–8.5 cm. long and 2.4–3.5 cm. wide, rounded at the base, narrow and acute at the apex, the margin minutely serrate-crenate, the midrib impressed above, rather thick and prominent below, the lateral veins numerous and evident on both surfaces.

No material of this species has been available for study. However, the original description shows clearly that the species belongs to *Cleyera*.

The only specimen of *Cleyera* from Santo Domingo examined by me is *Fuertes 1054* cited dubiously under *C. albo-punctata*. I tried to place this specimen with Schmidt's *C. Bolleana* but the leaves are so thick and coriaceous that they could never be confused with the "membranaceous" leaves of the present species.

5. **Cleyera Matudai**, sp. nov.

Planta lignosa, arbor videtur, ramulis teretibus brunnescentibus pubescentibus. Folia membranacea, primo pubescentia mox glabrescentia, obovata, 7–11 cm. longa et 2.5–3.7 cm. lata, apice basique attenuata margine crenata, costa supra complanata, venarum ca. 8–10 paribus undique inconspicuis, petiolo 3–4 mm. longo. Flores axillares 1- vel 2-fasciculati; pedicelli glabri, ca. 8–12 mm. longi, bracteolis 2,

suboppositis vel alternatis, cito caducis; sepala 5, imbricata, inaequalia, glabra, 2.5–3.0 mm. longa et ca. 2.0–2.5 mm. lata, apice obtusa apiculata margine ciliolata; petala 5, inaequalia, imbricata, ca. 6 mm. longa et 5–6 mm. lata, glabra, apice subrotundata vel emarginata; stamina 30, uniseriata, filamentis 3.5–4.0 mm. longis basi incrassatis et petalis adnatis apice sparse hirsutis; antheris obovatis parvis 0.50–0.75 mm. longis basi attenuatis, loculis inaequalibus apiculatis; ovarium subglobosum, glabrum, ca. 2 mm. longum, in stylum attenuatum triloculare, multi-ovulatum; stylus parvus, 1.5–2.0 mm. longus, glaber, ad medio tri-partitus. Fructus ignotus.

DISTRIBUTION: Mexico (Chiapas).

MEXICO. Chiapas: Mt. Ovando, alt. 1250–2370 m., *E. Matuda 2560* (AA, TYPE; FM, NY), July 1938. — Finca Irlanda, *C. A. Purpus 7433* (AA, FM, G, MO, NY, US), June 1914.

In general appearance this species exhibits no outstanding obvious characteristics to distinguish it from other species. However, the stamens, 30 in number, with the small obovate anthers (0.50–0.75 mm.) attenuated at the base, and the filaments sparsely hirsute just below the anthers are characters that easily separate the species from all others. Also the short style (1.5–2.0 mm.), free for nearly ½ its length and the membranaceous leaves are other distinguishing features.

Unfortunately, in both collections cited above, just the barest field notes are available. One can only surmise that the species is a tree in habit.

6. **Cleyera cernua** (Tulasne), comb. nov.

Freziera cernua Tulasne in Ann. Sci. Nat. sér. 3, **8**: 338. 1847.
Eurya cernua (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III, **6**: 190. 1893.

DISTRIBUTION: Mexico (Oaxaca).

OAXACA: Canetze, alt. 900 m., *H. Galeotti 1686* (TYPE of *Freziera cernua,* Genève; isotypes NY, US; photo and fragment, FM); La Lagune, *C. Liebmann 337,* in part (NY, US); *338* (FM, US), August 1842.

This species is characterized by the outstanding rufous, pilose buds, branchlets and undersurface of leaves (especially the midrib). On the older branchlets this pubescence appears black. Other notable characters are the many-flowered fascicles and the connivent, acute calyx-lobes.

Tulasne, in his original description, refers to the inflorescence as 2–4-flowered. Unfortunately, *Galeotti 1686,* from which the descrip-

tion was drawn, proves to be a very poor specimen. A photograph of the type in Geneva shows only eight flowers on the whole specimen. On both *Liebmann 337* and *338* single fascicles possess up to 9–10 flowers, more flowers than can be found on the entire type specimen. Tulasne records the leaf-measurements as 8–10 cm. long and 3.5–4.5 cm. wide. The more complete Liebmann numbers show leaves up to 15 cm. long and 5 cm. wide. According to Tulasne, the calyx-lobes should be 4–5 mm. long and the pedicels 1.0–1.5 cm. long. On the isotypes (NY, US) the calyx-lobes are seldom over 3 mm. long and the pedicels are always less than 1 cm. long. Although only a millimeter or so in variation in length of calyx-lobes, this variation proves interesting because the three-parted style protrudes beyond the calyx-lobes after the petals have fallen. The calyx-lobes are more acute in this species than those of most other species of the genus and the outer lobes are mucronulate as well as ciliolate. Instead of spreading, as is usually the case, the calyx-lobes are connivent, even after anthesis. In the type, the bracteoles are subopposite and close to the calyx. In the Liebmann specimens the bracteoles are usually 2–3 mm. apart. The pedicels are recurved as are those of most species.

The species is most closely related to *C. integrifolia* (Bentham) Choisy, from which it can be separated by the many-flowered fascicles, the usually shorter pedicels, the densely rufous-pilose young parts, the more acuminate leaves, pilose beneath, with a tendency towards serration, and the acute connivent calyx-lobes.

7. **Cleyera revoluta,** sp. nov.

Arbor parva, ca. 10 m. alta, ramis ramulisque teretibus pubescentibus brunnescentibus. Folia 5–9 cm. longa, et 1.5–2.5 cm. lata, revoluta, coriacea, oblanceolata, pubescentia, apice obtusa vel subrotundata, basi cuneata in petiolum 7–10 mm. longum attenuata, supra viridia, subtus argentea, margine crenata, nervis lateralibus 8–10 undique subobscuris. Flores non visi. Fructus immaturi in axillis solitarii, apice leviter pubescentes, pedicellis pubescentibus scabris 1.5–1.7 cm. longis, bracteolis 2 suboppositis cito caducis, sepalis 5 inaequalibus imbricatis pubescentibus 3.0–3.5 mm. longis et 3.5–4.0 mm. latis subrotundatis, stylis persistentibus glabris 3.5–4.0 mm. longis, 3–4-partitis medio liberis.

Distribution: Central America (Guatemala).

Guatemala: Dept. San Marcos, between La Vega ridge along Rio Vega and northeast slope of Volcán Tacaná, to three miles from Guatemala-Mexico boundary, in vicinity of San Rafael, alt. 2500–3000 m.,

J. A. Steyermark 36208 (FM), February 20, 1940 (tree 35 ft. tall; leaves "involute", coriaceous, rich dark green above, silvery beneath).

Although the material from which this species is described lacks both flowers and mature fruit, the fact that it represents a distinctive new species is unquestionable. Distinguishing characters are the revolute oblanceolate leaves, pubescent in the mature state rather than glabrescent, and the sturdy pubescent pedicels and calyx. The sparsely pubescent immature fruit suggests a pubescent ovary. In this character it resembles the Asiatic *Eurya trichocarpa* Korthals which possesses a densely hirsute ovary that on maturing becomes quickly glabrescent belying the specific name.

Since only two fair-sized fruits are present, one with a 3-parted style and the second with a 4-parted style, it seems inadvisable to sacrifice either of them for sectioning. In both cases the style is free for nearly one-half its total length.

8. **Cleyera tacanensis,** sp. nov.

Arbor 9-metralis, ramulis brunneis hornotinis pilosis. Folia obovata, subcoriacea, pubescentia, 5–10 cm. longa et 3–5 cm. lata, apice obtusa vel abrupte acuminata, basi cuneata, supra opaca, pulchre viridia, subtus pallidiora, margine acute serrata, costa supra canaliculata, venis utrinsecus 9–10 supra impressis, subtus manifeste prominentibus, petiolo 2–4 mm. longo. Flores pauci in axillis solitarii; pedicelli scabri, pubescentes, (5–) 7–12 mm. longi, crassi, apice 2 mm. diam., bracteolis cito caducis; sepala 5, pubescentia, inaequalia, imbricata, obtusa, 2.5–3.0 mm. longa et 3–4 mm. lata, ciliolata; petala 5, alba, inaequalia, imbricata, obovata, apice retusa, glabra (medio dorso excepta), 6–8 mm. longa et 7 mm. lata; stamina ca. 25, filamentis inaequalibus 3–5 mm. longis, antheris ovatis glabris 1.25–1.50 mm. longis apiculatis (etiam bi-apiculatus); ovarium subglobosum, glabrum 3 mm. longum et latum, rubidum, triloculare, multo-ovulatum; stylus crassus, 3 mm. longus et 1 mm. diam., ad medium tri-partitus. Fructus ignotus.

DISTRIBUTION: Central America (Guatemala) and Mexico (Chiapas).

GUATEMALA: Dept. San Marcos, along Quebrada Canjulá, between Sibinal and Canjulá, Volcán Tacaná, lower slopes, alt. 2200–2500 m., *J. A. Steyermark 36052* (TYPE, FM), Feb. 18, 1940 (tree 30 feet with subcoriaceous leaves and white flowers). — Dept. San Marcos, Rio Vega, near San Rafael and Guatemala — Mexico boundary, Volcán Tacaná, alt. 2500–3000 m., *J. A. Steyermark 36280* (FM), Feb. 20, 1940 (tree 25 ft. tall with rigid coriaceous leaves). — Dept. San Marcos, along Quebrada, Canjulá, between Sibinal and Canjulá, Volcán Tacaná, alt.

2200–2500 m., *J. A. Steyermark 36026* (FM), Feb. 18, 1940 (leaves subcoriaceous, rich green above, paler beneath).

Mexico. Chiapas: Chiquihuite, Volcán Tacaná, alt. 2800 m., *E. Matuda 2845* (AA, NY), Mar. 27, 1939. — Pasitar, *E. Matuda 394* (AA, MO, US), Dec. 1936.

This unusual species is characterized by large, obovate, sharply serrate leaves of a distinctive subcoriaceous texture. The pedicels are sturdy (2 mm. diam. below calyx), scabrous pubescent. The calyx-lobes are quite densely pubescent, wider than long. The petals are white, unequal, large, wider than long (6–8 mm. long and 7–9 mm. wide) with a dense pubescence, similar to that of the calyx, found along the medial strip of the dorsal surface. The stamens have rather long filaments (3–5 mm.). The anthers are glabrous (unique for the genus) and the projection in some instances appears forked. The style is sturdy, ca. 3 mm. long, three-parted for one-third its length with an obvious tendency toward further separation.

There is considerable variation found in the other specimens cited above. *Matuda 394* is placed here dubiously. The leaves are less sharply serrate, in most cases appearing subentire. The flowers are many — but unfortunately only in bud. Upon dissection, the anthers are sparsely hirsute whereas in the type the anthers are glabrous.

The species seems to be quite localized in the vicinity of Volcán Tacaná on the Chiapas-Guatemala border.

9. **Cleyera serrulata** Choisy in Mem. Soc. Phys. Hist. Nat. Genève **14, 1:** 110. 1855.

Ternstroemia serrulata Herb. Pavon, ex Choisy l. c.

Distribution: Mexico (Hidalgo).

Mexico: Hidalgo, vicinity of Chiconquiaco, *G. Schiede 325* (MO). — exact locality unknown, "*Sessé, Mociño, Castillo & Maldonado 2331*" (FM, probable isotype).

Choisy (l. c.) in making the combination states: "5 *Cl. serrulata*. Nob. — *Ternstroemia serrulata*. Herb. Pavon! — Plante du Mexique également fort analogue au *Cl. integrifolia* et offrant, comme celleci, des sépales velus; elle en differe principalement par ses feuilles dentées en scie dans la partie supérieure." No actual type was cited — nothing but a reference to a specimen in Herb. Pavon. However, Pavon was not known to have collected in Central America or Mexico where most species of *Cleyera* abound. No species of *Cleyera* has been found in Peru where Pavon did most of his collecting.

Standley (Contrib. U. S. Nat. Herb. **23, 1:** 17. 1920) remarked that probably many Sessé and Mociño specimens were distributed from the Madrid herbarium by Pavon and through some error, Pavon's name was affixed to the labels. In the herbarium of the Field Museum of Natural History is a specimen from the herbarium of the botanical garden of Madrid (Norti Botanici Matritensis) collected by *"Sessé, Mociño, Castillo* et *Maldonado* . . . (1787–1795–1804)." This specimen has two labels (1) *Ternstroemia serrulata* and (2) *Ternstroemia parviflora* N. Arbor 13 ped. Probably Choisy had a duplicate of this specimen before him and cited it as *T. serrulata* Herb. Pavon. As Choisy stated in his brief description, the pubescent calyx and serrulate leaves separate the species from *C. integrifolia.*

Here also might be cited *C. A. Purpus 6177* (MO) collected between Misantla and Naolinco, Vera Cruz, Aug. 1912. The serration of the leaves of this specimen is more outstanding than that found on the two specimens cited above.

One may assume from the specimens cited that the range of this species lies in southeastern Mexico. Since no complete description of this species has ever been recorded, the following description has been drawn from the type:

Small tree about 4 m. tall with brown glabrescent branchlets. Leaves coriaceous, obovate, glabrescent, 5–8 cm. long, 2–3 cm. wide, obtusely acuminate at the apex, dark green above, paler beneath, cuneate at the base, the margin serrulate, the lateral veins (8–10 pairs) impressed on the upper surface, conspicuous below, the petiole 4–5 mm. long. Flowers few, solitary in the axils, the pedicel appressed pilose, ca. 1 cm. long, the bracteoles quickly caducous; sepals 5, unequal, imbricate, densely hirsute, 3.0–3.5 mm. long, 3–4 mm. wide, rounded at the apex, the outer sepals apiculate; petals 5, unequal, imbricate, obovate, glabrous or sparingly pubescent on medial portion of dorsal surface, ca. 6 mm. long, 4–5 mm. wide, rotundate or emarginate at apex; ovary globose, ca. 2.5 mm. long, hirsute at the apex with pubescence extending sparingly onto style; style short, 1.25–1.50 mm. long, 3-parted, free for one-third distance. Fruit unknown.

10. **Cleyera Skutchii,** sp. nov.

Arbor ad 20-metralis (fide collectoris), ramulis brunneis hornotinis ad apicem subadpresse pilosulis, mox glabrescentibus. Folia oblongo-elliptica vel obovata, coriacea, glabra juventate excepta, 3.5–8.0 cm. longa et 1.0–2.7 cm. lata, apice acuminata, basi cuneata in petiolum 3–4 mm. longum attenuata, margine serrata, nervis lateralibus 10–12

undique prominentibus. Flores in axillis solitarii; pedicelli glabri, recurvi 5–7 mm. longi, bracteolis 2 suboppositis ovatis ± 1.5 mm. longis cito caducis; sepala 5, inaequalia, imbricata, concava, pergamenacea, rotundata, exteriora pubescentia, 2.5–3.0 mm. longa et ca. 2 mm. lata margine ciliolata; petala 5, alba, glabra, inaequalia, imbricata, emarginata, ca. 6.0–6.5 mm. longa et 5–6 mm. lata; stamina uniseriata, ca. 25, filamentis 3–4 mm. longis basi manifeste crassis et petalis adnatis, antheris sparse hirsutis vel subglabris oblongis ± 1 mm. longis apiculatis (0.25–0.50 mm. longis); ovarium subglobosum in stylum attenuatum, glabrum, ca. 2 mm. longum, tri-loculare, multi-ovulatum; styli 3, ad medium vel plerumque ad basin liberi. Fructus ignotus.

DISTRIBUTION: Central America (Guatemala) and Mexico (Chiapas).

GUATEMALA. Dept. Chimaltenango: Chichavac, alt. 2400–2700 m., *A. F. Skutch 545* (TYPE AA; isotypes FM, NY, US), Aug. 18, 1933 (common tree, 60 ft. high with white flowers). — Chichavac, dry oak woods, alt. 2400–2700 m., *A. F. Skutch 271* (US), Feb. 21, 1933. — Chichavac Tecpan, *J. G. Salas 1395* (FM), Dec. 1929 (tree 6–8 m.). Dept. Chiquimula: upper slopes of Montaña Tajurán, in vicinity of El Barriol, alt. 1200–1700 m., *J. A. Steyermark 30814* (AA, FM), Oct. 28, 1939 (tree 50 ft. with leaves dark dull green above). Dept. Zacapa: forested slopes near summit of Sierra de las Minas, near Finca Alejandria, alt. 2000 m., *J. A. Steyermark 29805* (AA, FM), Oct. 12, 1939 (shrub with sweet-scented, white flowers, the stamens yellow, the style green; leaves slightly thick, dark green above, paler beneath). Dept. Jalapa: Cerro Alcoba, just east of Jalapa, oak woods near summit, alt. 1300–1700 m., *J. A. Steyermark 32559* (FM), Dec. 2, 1939 (tree 20 ft. with firm subcoriaceous leaves, dark green above, pale silvery gray beneath). — Between Miramundo and summit of Montaña Miramundo, between Jalapa and Mataquescuintla, six miles south of Miramundo, alt. 2000–2500 m., *J. A. Steyermark 32778* (FM, NY), Dec. 5, 1939 (tree 20 ft. with leaves dark green above, silvery beneath, *"barratillo"*). Dept. Guatemala: Volcán de Pacaya, above Las Calderas, in moist open forest, alt. 1800–2400 m., *P. C. Standley 58402* (FM), *58471* (AA, FM), Nov. 30, 1938 (large tree with greenish white flowers). Dept. Sacatepequez: Santiago, alt. 2000 m., *R. Gómez 790* (G, MO, NY, US). Dept. Sololá: Sololá, alt. 2250 m., *A. F. Skutch 1057* (AA) Aug. 27, 1934.

MEXICO: Chiapas, Mt. Pasitar, *E. Matuda S-211* (AA, MO, NY, US), Aug. 3, 1937.

This species is characterized by short pedicels (5–7 mm.), the white emarginate petals, the rather long filaments (3.5–4.0 mm.), swollen at the base, the anthers only slightly hirsute and distinctly apiculate (0.25–0.50 mm.) and the styles free to the base or nearly so. These characters serve to distinguish the species from *C. costaricensis*, its nearest relative.

The pedicels are unusually short for the genus. In the type, the bracteoles are situated at the apex of the pedicels, close to the calyx-lobes, and are subopposite. In *Steyermark 29805* and *Standley 58471*, the bracteoles are alternate, with the lower bracteole situated nearly half-way down the pedicel. It is unusual to find white flowers in the genus; in most other species they are yellow, greenish yellow or even bronze.

Skutch 271, according to the collector, is a fruiting specimen of the type, or at least, of the same species. The leaves are much larger, up to 12 cm. long and 5 cm. wide and a mature fruit (crushed in pressing) measures about 1 cm. across.

Also dubiously cited here might be *E. A. Goldman 961* (US) from Teopisca, Chiapas. On this specimen the lateral veins number as many as fifteen pairs and in most cases appear nearly at right angles to the midrib, although in some leaves the lateral veins are at nearly forty-five degree angles.

11. **Cleyera costaricensis**, sp. nov.

Frutex 2–5 m. altus, ramulis griseis hornotinis ad apicem breviter et subadpresse pilosulis, mox glabrescentibus. Folia oblongo-elliptica, coriacea, glabra juventate excepta, 3–5 cm. longa et 1–2 cm. lata (etiam pauca 6–8 cm. longa et ± 3 cm. lata), apice obtusa vel abrupte acuminata, basi in petiolum 2–3 mm. longum attenuata, margine serrata, nervis utrinsecus 10–11 subtus manifeste prominentibus. Flores in axillis solitarii vel plures; pedicelli glabri, recurvi, 10–14 mm. longi (*Stork 2592* ad 20 mm.), bracteolis 2 subopppositis vel ad 4 mm. distantibus linearibus 2–3 mm. longis cito caducis; sepala 5, glabra, concava, pergamenacea, acuta ± 3 mm. longa et 2.0–2.5 mm. lata; petala 5, inaequalia, imbricata, cuneiformia, 6–7 mm. longa et 6–8 mm. lata, apice truncata vel retusa; stamina uniseriata, ca. 25, filamentis 2.0–2.5 mm. longis glabris basi manifeste crassis et petalis adnatis, antheris hirsutis obovatis ± 1 mm. longis breviter apiculatis; ovarium subglobosum in stylum attenuatum, glabrum, ca. 2 mm. longum, triloculare, multi-ovulatum; stylus ca. 2 mm. longus, ad medium tripartitus. Fructus ignotus.

DISTRIBUTION: Central America (Costa Rica).

COSTA RICA: Forêts du Copey, alt. 1800 m., *A. Tonduz 11716* (TYPE, US), February 1898 (flowers green-white). — Cerro de las Vueltas, wet forest, alt. 3000 m., *P. C. Standley 43588* (US, FM), Jan. 1, 1926 (shrub 10–15 ft. with dark green leaves and bronze-green flowers). — Santa Clara hills, in old cut-over land, alt. 1800 m., *H. E. Stork 2592* (FM), June 6, 1928 (shrub 6 ft. with waxy yellow flowers).

This species is characterized by very small leaves (3–5 cm. long) especially on the flowering branches. Occasionally, larger leaves are present. In the type, two sheets of which were examined, only two leaves measured above 5 cm. The apex is acute and the base tapers into a short petiole. Except for the very young parts, the species is strictly glabrous. The pedicels are semi-recurved.

In *C. panamensis,* although originally described as small-leaved (specimens since collected prove the type exceptional) the leaves are obtuse or rounded at the apex, the margin is crenulate and the calyx-lobes are covered with a short appressed pubescence.

12. **Cleyera nimanimae** (Tulasne) Krug & Urban in Bot. Jahrb. **21**: 540. 1896.

Freziera nimanimae Tulasne in Ann. Sci. Nat. sér. 3, **8**: 338. 1847. — Walpers, Ann. Sci. Nat. **1**: 120. 1848.

?Freziera ilicioides Tulasne in Ann. Sci. Nat. sér. 3, **8**: 337, 1847. — Walpers, Ann. Sci. Nat. **1**: 120. 1848.

Cleyera nimanimae (Tulasne) Krug & Urban var. *β viridula* Krug & Urban in Bot. Jahrb. **21**: 540. 1896.

Eurya nimanimae (Tulasne) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 147. 1925.

DISTRIBUTION: West Indies (Cuba).

CUBA: S. Yago, Pinol de Nimanima, *J. Linden 2128* (ISOTYPE of *Freziera nimanimae,* FM). — Southern Baracoa region, crest of Punta del Mata, alt. 1230 m., *Fr. Leon 12159* (NY), July–August 1924 (small tree, 5–6 m.). — Near Monte Verde, in dense woods, *C. Wright 1126* (ISOTYPE of *C. nimanimae* var. *viridula,* AA, G, FM, MO), Aug. 2, 1859 (tree 50 ft. with yellowish green flowers).

To my mind this is a rather dubious species. The type itself is distinguished from the other material at hand by the narrow oblong-elliptic leaves. It is closely allied to *C. theaeoides,* the Jamaican species, but can be separated by the leaf shape, smaller floral parts and the pubescent calyx.

The three specimens cited above conform quite well to the description

of the species. However, *Wright 1126* presents an interesting problem. There are available for my study five specimens of this number. Were it not for the specimen from the Field Museum, I could only conclude that two distinct species or forms had been included in the collection. However, this specimen has both the narrow elliptic leaves of *C. nimanimae* and the broader obovate leaves of *C. theaeoides* on a single branchlet.

Other specimens dubiously placed here are *Fr. Leon* et al. *10610, 10172, 10979,* and *E. L. Ekman 14701.* These collections have broader leaves, similar in shape to *C. theaeoides,* still they possess the smaller flowers and pubescent calyx of *C. nimanimae.*

Urban, in a key to the West Indian species of *Cleyera,* separated these two species by the absence or presence of buds at the base of the pedicel, besides leaf-shape and size. In the type of *C. nimanimae, Linden 2128,* this character (absence of buds) does hold, but in *Fr. Leon 12159* (representing *C. nimanimae*) and the material examined of *C. theaeoides* both the presence and the absence of buds can be noted.

Dubiously cited under this species as a synonym is *Freziera ilicioides* Tulasne. Urban cited *F. ilicioides* under *Cleyera theaeoides.* Unfortunately, I have not been able to examine the type material but from the extensive description I feel that it is more closely associated with the present species.

13. **Cleyera panamensis** (Standley), comb. nov.

Eurya panamensis Standley in Woodson & Seibert in Ann. Missouri Bot. Gard. **25**: 829. 1938; in Field Mus. Nat. Hist. Publ. Bot. Ser. **22**: 169. 1940.

DISTRIBUTION: Central America (Panama and Costa Rica).

PANAMA. Prov. de Chiriquí: valley of upper Rio Chiriquí Viejo, alt. 1300–1900 m., *Gene & Peggy White 16* (TYPE of *Eurya panamensis,* FM; isotype, AA), July 16, 1937 (tree 10–12 m. high with white, very fragrant flowers). — Vicinity of Casita Alta, Volcán de Chiriquí, alt. 1500–2000 m., *Woodson, Allen & Seibert 791* (AA, FM, MO), June 28 – July 2, 1938 (tree 6 m. high with yellow flowers). — Vicinity of Finca Lérida, Volcán de Chiriquí, alt. 1750 m., *Woodson & Schery 232* (AA, MO), July 7–11, 1940 (tree 10 m. high with yellow-cream flowers). — Vicinity of Callejón Seco, Volcán de Chiriquí, alt. 1700 m., *Woodson & Schery 499* (AA, MO), July 17, 1940 (tree 6 m. with pale yellow flowers). — Volcán de Chiriquí, Boquete Distr., open hillsides, alt. 1500–2700 m., *M. E. Terry 771* (AA, FM, MO), *785* (FM), *880* (AA, FM, MO), *922* (FM), *1350* (FM), June 26, 1935 –

Feb. 13, 1940 (tree 5–9 m. with pale yellow, greenish yellow or greenish white flowers).

COSTA RICA: hills above Zarcero, in woodland, alt. 1800 m., *Austin Smith A127* (AA, FM, MO), Aug. 14, 1935 (tree 6 m. with campanulate flowers [15 mm. across], pale citron yellow; bark dark gray, thick, granularly roughened, the wood white). — Alajuela, Palmira, alt. 2100 m., *Austin Smith 4166* (FM), Apr. 30, 1937 (tree 50 ft.; 2 ft. diam. at base, bark grayish, corrugated; flowers semi-campanulate, yellow to mustard yellow, 15 mm. across). — Paso Ancho, alt. 1675 m., *C. H. Lankester 287* (FM), June 1919.

Standley distinguishes this species by the small obovate leaves (2.5–5.5 cm. long, 1.0–2.5 cm. wide), very obtuse or rounded at the apex. On the type in the Field Museum, this character holds true. However, on the isotype in the herbarium of the Arnold Arboretum, leaves are found measuring up to 8 cm. × 3 cm. Most of the specimens cited above have larger leaves, with the smaller leaves the exception. The apex of the leaves may be very obtuse or rounded or, as found on later specimens, obtuse but bluntly acuminate. Very characteristic are the densely hirsute, white or greenish white terminal buds. In a group of plants where characters are most variable, this character is consistent. The pubescence carries through on the very young branchlets and younger leaves, especially on the petiole and undersurface. The older leaves appear glabrous or nearly so.

The calyx-lobes, under the hand-lens, may seem glabrous, but under the binocular, they usually appear covered with a dense appressed pubescence. This pubescence is usually found on the inner surface of the calyx-lobes as well.

The serration of the leaves varies somewhat from the distinct dentation as found in the type to the nearly entire margin found in *Terry 771* and *922*.

From *C. costaricensis* this species can be separated by the obtuse acuminate or rounded apex, the texture and veining. In *C. costaricensis* the leaves are in some instances even smaller than the type of this species, quite coriaceous, acute at the apex and less abruptly acuminate.

14. **Cleyera theaeoides** (Swartz) Choisy in Mém. Soc. Phys. Hist. Nat. Genève **14, 1:** 110. 1855 "thoeoides." — Grisebach, Fl. Brit. West Ind. Isl. 103. 1859. — Urban in Bot. Jahrb. **21:** 538. 1896.

Eroteum theaeoides Swartz, Prodr. 85. 1788. — Fawcett & Rendle in Jour. Bot. **60:** 362. 1922; Fl. Jam. **5:** 185. 1926.

Freziera theoides Swartz, Fl. Ind. Occ. **2:** 972. 1800. — Willdenow, Sp. Pl. **2, 2:** 1179. 1800. — Smith in Rees, Cyclop. **15:** no. 1. 1810. — De

Candolle, Prodr. **1**: 524. 1824. — Macfadyen, Fl. Jam. **1**: 115. 1837. — Hooker in Bot. Mag. **76**: t. 4546. 1850. — Paxton's Fl. Gard. **1**: 189. 1851. — Seemann, Bot. Voy. Herald, 87. 1853. — Triana & Planchon in Ann. Sci. Nat. Bot. sér. 4, **18**: 264. 1862.

Eurya theoides (Swartz) Blume, Mus. Bot. Lugd.-Bat. **2**: 105. 1856. — Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 189. 1893. — Standley in Contrib. U. S. Nat. Herb. **23, 3**: 823. 1923. — Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 147. 1925.

DISTRIBUTION: West Indies (Jamaica).

JAMAICA: vicinity of Cinchona, *N. L. Britton 109* (NY), Sept. 2–10, 1906. — Vicinity of Newcastle, hillside, Silver Hill to Hardware Gap, *N. L. Britton 3447* (NY), Sept. 11, 1908 (tree 10 m.). — Road to John Crows Peak, alt. 1860 m., *W. Harris 6513* (NY, FM), Sept. 8, 1896 (tree 10 m.). — Cinchona, Sir John's Peak, alt. 1830 m., *W. Harris 9514* (NY), Sept. 27, 1906 (small tree 10–12 ft.). — Content Road, alt. 900 m., *W. Harris 6104* (AA, NY), Nov. 21, 1895 (small tree, 15 ft.). — Morce's Gap, *W. Purdie s.n.* (G), June 1843; *J. H. Perkins 1132* (AA, G), May 22, 1916; *F. Shreve s.n.* (NY), Jan. 1906. — Cinchona, leeward slopes of Blue Mts., *J. A. Harris & J. V. Lawrence C 15180A, C 15361, C 15374A*, Feb. & Mar. 1916. — Blue Mountain near Portland Gap, alt. 1700 m., *A. Rehder s.n.* (AA), Feb. 11, 1903 (tree 20 ft. high with rather smooth brown bark; fls. yellowish white). — on summit of Blue Mountain Peak, alt. 2225 m., *A. Rehder s.n.* (AA), Feb. 11, 1903 (shrub 10 ft.). — extreme summit of Blue Mountain Peak, alt. 2262 m., *W. R. Maxon 1405* (US), Apr. 1903 (shrub 8–12 ft.). — Blue Mountain Peak, open southeastern slope of East Peak, alt. 2200 m., *W. R. Maxon 9949* (US), July 1926 (shrub 2.5 m.). — Blue Mountain Peak, summit, alt. 2250 m., *G. E. Nichols 116* (FM, G, MO, NY, US), July 21, 1903. — Gordon Town (Cinchona plantation), *J. Hart 593, 654, 1051* (US).

Shrubs or small trees up to 20 ft. Branchlets and terminal buds appressed pilose becoming glabrous. Leaves obovate or oblong-obovate, chartaceous-coriaceous, glabrous, 4–8 cm. long and 2–4 cm. wide, bluntly acuminate (rarely attenuate) at the apex, sharply or broadly cuneate at the base, the lateral veins inconspicuous above, prominent below, anastomosing near the crenulate or crenate margin; petiole 3–7 mm. long.

Flowers solitary, rarely in two's in the axils; pedicels glabrous, 1–2 cm. long, the bracteoles 2, usually deciduous before anthesis, when present, linear, membranaceous up to 2 mm. long; sepals unequal, semi-orbicular, glabrous, outer sepals smaller, 2.0–3.5 mm. across, inner sepals 3.5–5.0 mm. wide, ciliolate; petals ± 1 cm. long, obtuse, glabrous

on dorsal surface; stamens 25–30, the filaments 3–5 mm. long, adnate to the base of the corolla, the anthers oval-elliptic, ± 1 mm. long, sparsely hirsute; ovary glabrous, globose, 3-locular, 14–18 ovules in each locule, the style 2–3 mm. long, 3-parted with a tendency to split simulating *Eurya*. Fruit globose, about 1 cm. diameter.

The crenulate leaf-margin is similar to that found in the Japanese species, *Eurya japonica*.

In his original description of this species under the genus *Eroteum* (1788), Swartz used the spelling "*Theaeoides*." In 1800, under the genus *Freziera*, Swartz changed this spelling to "theoides." Choisy (1855), in making the transfer to the genus *Cleyera* used "thoeoides." Since then, most authors have used "theoides," the later spelling employed by Swartz. However, Fawcett & Rendle, as well as Sprague, in discussions over the correct generic name, used the original "theaeoides." Personally, I feel the second name more euphonious and it is surely easier to record. Nevertheless, to my mind, the change to this name by Swartz was merely an oversight. *I do not believe it to be a correction*. Since the original spelling seems correct enough grammatically, it should be employed.

From the material examined, one is not impressed by the range of the species in Jamaica. All the material seems to have been collected in the southeastern portion of the island, on or close to Blue Mountain. This is due, perhaps, to the fact that most collectors worked from a base established at Kingston. However, were it collected elsewhere, surely it would be found in one of the various herbaria, whose material I have at my disposal.

15. **Cleyera vaccinioides** (O. C. Schmidt), comb. nov.

Eurya vaccinioides O. C. Schmidt in Rep. Spec. Nov. **22**: 98. 1925.
Freziera vaccinioides (O. C. Schmidt) Kobuski in Ann. Missouri Bot. Gard. **25**: 355. 1938.

DISTRIBUTION: West Indies (Haiti).

HAITI: Massif de la Selle, Pétionville, slope of M. Le Visite, on top of limestone ridge in exposed situation, alt. 2100 m., *E. L. Ekman H 1438* (ISOTYPE of *Eurya vaccinioides*, US). — Massif de la Hotte, pinelands, alt. 2300 m., *E. L. Ekman H 10628* (US), Sept. 13, 1928.

The most outstanding character of this species is found in the minute elliptic or obovate leaves, measuring 1.0–1.8 cm. long and usually less than 1 cm. wide with a petiole 1–2 mm. long. Also, the leaves are coriaceous, punctate on the upper surface, appressed strigose pubescent beneath, the veins obscure and the margin revolute with a few dentations at the very apex.

Unfortunately, as Schmidt intimated in his original diagnosis, the petals and the stamens can be found only in the unopened buds. However, Schmidt states that the petals were suborbicular and densely pilose up the center. The pedicels are only 0.5 mm. long.

Closely allied to *C. vaccinioides* is *C. ternstroemioides* which differs in its larger leaves (2.0–3.3 cm. long and 1.4–1.9[–2.2] cm. wide), glabrous on the under surface. In the latter species, the very young parts (branchlets and leaves) are appressed-pilose, later becoming glabrous. There are fewer leaves because of the longer internodes which are 5–6 mm. long as compared with the 2–3 mm. long internodes of *C. vaccinioides*.

16. **Cleyera ternstroemioides** (O. C. Schmidt), comb. nov.

Eurya ternstroemioides O. C. Schmidt in Rep. Spec. Nov. **24**: 79. 1927.
Freziera ternstroemioides (O. C. Schmidt) Kobuski in Ann. Missouri Bot. Gard. **25**: 355. 1938.

DISTRIBUTION: West Indies (Haiti).

HAITI: Massif de la Hotte, western group, Torbec, top of M. Formona, alt. 2225 m., *E. L. Ekman H 7487* (ISOTYPE of *Eurya ternstroemioides*, US), January 1, 1927.

Cleyera ternstroemioides is characterized by glabrous, coriaceous elliptic to obovate leaves, 2.0–3.3 cm. long and 1.4–1.9(–2.2) cm. wide, rotund at both ends, with the margin slightly dentate at the apex, punctate on the upper surface, the midrib sulcate above, the veins obscure on both surfaces. The branchlets and leaves are appressed-pilose at first, later becoming glabrous. The pedicels are about 1 cm. long. The petals are obcordate-orbicular, 8.5–10 mm. long and 8–9 mm. wide, densely pilose on the medial portion of the dorsal surface, ciliolate along the margin. The anthers are sparsely hirsute.

Closely related is *C. vaccinioides* which can be separated by its even smaller flowers (one-half), the appressed-pilose undersurface of the leaves and branchlets, the short internodes (2–3 mm.) and pedicels (0.5 mm.).

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

THE TRIBE PLUKENETIINAE OF THE EUPHORBIACEAE IN EASTERN TROPICAL ASIA

LEON CROIZAT

Two specimens of Euphorbiaceae were found in the collections made by C. W. Wang in Yunnan, during 1938, which have a gross morphology suggesting that of *Tragia* L. A dissection made of their flowers shows that: (1) the ♂ perianth has three broadly triangular lobes, alternating with as many large triangular stamens, with an apical dehiscence and very short appendages; (2) the stamens stand upon a short column, without a central pistillode, and are surrounded by a slightly upraised, eglandular annulus, suggesting a similar structure commonly found in certain Asclepiadaceae of the Tribe Stapelieae; (3) the ♀ flower bears a style much thickened at the apex, without expanded stigmas.

Characters of this kind belong to several genera in the vicinity of *Tragia,* for instance, *Cnesmone* Bl., *Sphaerostylis* Baill., *Megistostigma* Hook f., *Clavistylus* J. J. Sm., *Cenesmon* Gagnep., and *Tragiella* Pax & Hoffm. Before the Wang collections could be determined all these genera had to be studied in detail, which necessarily entailed a consideration of the Tribe PLUKENETIINAE and its nearest allies. The result of this investigation proved to be fruitful of taxonomic and nomenclatural changes which are the subject of the present contribution.

In their latest work on the Euphorbiaceae, Pax & Hoffmann (Nat. Pflanzenfam. **19**[c]: 141–148. 1931) includes *Cenesmon* among the genera of the MERCURIALINAE. It is not apparent why they should do this, since they remark "Die Gattung zeigt Beziehung zu *Cnesmone*", which is closely related to *Tragia,* the type-genus of the PLUKENETIINAE. *Tragia* alone numbers about 140 species, and the balance of the species of the tribe, about 40, are distributed by Pax & Hoffmann among not less than twenty genera, eleven of which are monotypic. Clearly, genera of this nature cannot be critically worked out unless by making reference to *Tragia,* of which they are bound to be comparatively minor segregates.

Tragia is a critical genus, which Pax & Hoffmann (Pflanzenr. 68[IV.**147**. IX–XI]: 32–101. 1919) divide into nine so-called sections. These nine sections very nearly fall into two natural groups. In one

group the ♂ perianth is 3-lobed and the lobes alternate with as many stamens; in the other group, the ♂ perianth is 5-lobed and the stamens tend to be numerous. The stylar structure of the genus is variable throughout. Some species have evolute columns with divaricate stigmas (see, for instance, *T. Sellowiana* Muell. Arg. and *T. leucandra* Pax & Hoffm.). Others, on the contrary, have branches of the style that become divergent at the very top of the ovary (see, for instance, *T. geraniifolia* Baill. and *T. mitis* Hochst.). The stigmatic surfaces are more or less thickly and finely papillose. The stamens are more or less elongated, sometimes mixed with staminodes, but so far as I know the anthers bear no appendage arising from an extension of the connective between the cells, and the filaments are almost always delicate.

Like the majority of the genera of the Euphorbiaceae, *Tragia* is a natural group, covering species that are unlike in their morphology and, even more, in their tendencies. Such a group is essentially defined by negative characters and cannot be broken up at will into lesser units merely because some of its forms happen to have characters in their flowers that do not exactly fit the standard generic definition. *Tragia* is a phylogenetic node from which have radiated forms that ultimately have evolved along lines of their own. One of such lines, for instance, can readily be identified. It begins with the coarsely papillose and thick style of certain species of *Tragia,* and through *Cnesmone* it ends in *Plukenetia,* the stylar structures becoming larger and more deeply and intimately connate as the evolutive trend unfolds itself.

The earliest segregate from *Tragia* recorded in the botany of tropical Asia is *Cnesmone.* In publishing it as *Cnesmosa* (Bijdr. **12**: 630. 1825, corrected to *Cnesmone* in Blume & Fischer, Fl. Jav. **1**: vi *in nota.* 1828[1]), Blume laid stress upon the following: "Genus a *Tragia* diversum calice in femineis 3-sepalo, stigmatibus sessilibus carnosis intus verrucosis ut etiam habitu". None of the characters emphasized by Blume can validly separate *Cnesmone* from *Tragia.* The *species lectotypica proposita* of *Tragia* is *T. volubilis* L., which has a 3-lobed ♂ calyx and a 6-lobed ♀ perianth, this type of flower being also characteristic of certain species of *Cnesmone.* As has been pointed out, "stigmatibus sessilibus carnosis intus verrucosis" occur on *T. geraniifolia.* The habit,

[1]This reference is usually cited, following Pax & Hoffmann, op. cit., 102, as "Fl. Jav. praef. VI. (1828)," which is misleading. The introduction to the Flora Javanica referred to as "praef." is an integral part of the first volume of this work, paged in Roman numerals. Many important corrections are effected by Blume in this introduction. *Cnesmosa* is a "clearly unintentional orthographic error" under Art. 70 of the Rules of Nomenclature, which Blume was justified in correcting. *Cnesmone* alludes to the urent hairs of the type-species, *C. javanica,* as pointed out by Pax & Hoffmann, op. cit., 102 *in nota.*

of course, is very much alike in the genera of the PLUKENETIINAE, and *Cnesmone* quite agrees with the gross morphology of *Tragia*.

The fundamental difference between *Cnesmone* and *Tragia* is that of the anthers, which bear a manifest connective between the cells in *Cnesmone* and are exappendiculate, on the contrary, in *Tragia*. This difference, overlooked by Blume, is emphasized by Pax & Hoffmann in their key to the genera of the PLUKENETIINAE, in which they (op. cit., 9) say of *Tragia*: "Stamina numerosa vel plura, saepius autem 3. Ovarium 3-loculare; styli superne liberi" and refer to *Cnesmone* as having: "Stamina normaliter 3 vel 2. Ovarium 3-loculare. Antherae appendiculatae. Styli superne liberi." Mueller Argoviensis, on his part (in DC. Prodr. **15**[*2*]: 926. 1866), states that *Cnesmone* is "Planta fruticosa, scandens, habitu Tragiae, in Java et India orientali crescens, connectivi et stylorum indole insignita." This characterization of Blume's genus is correct, in the main. Unfortunately, it has often been read to mean that the thickened style of *Cnesmone* has generic importance. This is not necessarily true, because the stigma of *C. javanica* is essentially free, and as such is correctly illustrated by Pax & Hoffmann (op. cit., 103 fig. 23 E).

In his publication of *Cenesmon,* Gagnepain (in Bull. Soc. Bot. France **71**: 865–866. 1924) notices that this genus differs from *Tragia* because it has appendaged anthers with spreading cells, coarse and conical papillae on the stigmas and no stylar column. He furthermore states that *Cenesmon* is unlike *Cnesmone* because it has stigmas that spread in anthesis, conical stigmatic papillae and no stylar column. It is to be feared that in emphasizing differences such as these, Gagnepain relies too much on characters of the flower that are unimportant in the Euphorbiaceae. Since in *Tragia* a stylar column may be present or absent, and the stigmas may be finely or coarsely papillate, no reliance can be put upon the nature of the stylar column and of the stigma to effect generic segregations in this group. Shorn of unessentials, Gagnepain's notes amount merely to this: *Cenesmon* is generically distinct from *Tragia* because it bears appendaged anthers, and it differs from *Cnesmone* in having stigmas that spread at the time of anthesis.

The fact that the stigmas tend to be inflexed rather than to expand has absolutely no systematic significance in the PLUKENETIINAE. In this tribe, the style varies a great deal in the different stages of its growth, which is proved by van Steenis' illustration of the style of *Clavistylus peltatus* J. J. Sm. The two states which van Steenis (in Bull. Jard. Bot. Buitenz. iii, **12**: 201, *fig. 10 d, e.* 1932) shows are so different that taxonomists of the school of Gagnepain would hesitate in believing them to

be conspecific and perhaps even congeneric. At the very best, fully accepting the accuracy of Gagnepain's observations, *Cenesmon* could be maintained as a subsection of *Cnesmone* to include the species that have about reached a stage of evolution wherein their style *begins to look like* the style of certain species of *Tragia*. There can be no question of erecting two genera because the stigmas spread or fail to do so.

Cnesmone, as has been shown, differs from *Tragia* because it has appendaged anthers. Characteristically, *Cenesmon* is said by Gagnepain to differ from *Tragia* in the very same manner, that is to say, in carrying anthers that are appendaged. It is but a logical conclusion that *Cenesmon* is a synonym of *Cnesmone*, because none of the differences which are said to separate them has any value. It might be possible to treat *Cnesmone* as a subgenus of *Tragia*, denying generic validity to the presence or absence of the appendage in the anthers. Such a treatment, however, is neither necessary nor correct. *Cnesmone* is a good genus not because its anthers differ in some detail from those of *Tragia*. It is a good genus because it consists of species that are phylogenetically, phytogeographically and morphologically one unit, and form as such a natural group in the flora of eastern tropical Asia. It is conceivable that some of the species of *Cnesmone* may have anthers that are less manifestly appendaged than those of others, and that their position under *Cnesmone* may ultimately depend upon sums of intangibles rather than upon technicalities of floral morphology. Such technicalities have a very limited value in the Euphorbiaceae; were they stressed, every one of the fundamental genera of the family could be broken up into countless meaningless segregates.

I have not seen material of *Sphaerostylis Tulasneana* Baill. The classic illustrations of this species, prepared under the supervision of Baillon (Etud. Gén. Euphorb., *pl. 21, fig. 19–21.* 1858; in Grandidier, Hist. Madagascar **4**[xxix]: *pl. 196.* 1890) are fortunately very clear. In view of what they show it is safe to conclude that *Tragiella* Pax & Hoffm. is merely a synonym of *Sphaerostylis*. The lobes of the ♀ calyx are manifestly pinnatifid in *Tragiella*, but they are at least toothed in *Sphaerostylis*. The peculiar coarctate ♂ perianth of the former is described by Pax & Hoffmann (op. cit., 104) as: "Calyx ♂ valvatim 3-partitus, parte inferiore campanulatus, ad faucem introrsum plicatus, lobi deinde patentes." The perianth of *Sphaerostylis* likewise is characterized by the two authors (op. cit., 106) as: "Calyx ♂ ultra medium valvatim partitus; lobi demum transversim introsum plicati, quasi discum simulantes." The lobes of the ♀ perianth are about 6 in both genera. The style of *Tragiella* is described as: "Styli in columnam infun-

dibuliformem, apice trilobam, vel in massam globosam connati," and that of *Sphaerostylis* as: "Styli in massam globosam, longitrorsum trisulcam, ovario multo majorem connati, summo apice brevissime liberi." The differences in the stamens of the two genera are just as trifling as are those in the styles. In *Tragiella* the stamens are described as: "Stamina 3–4, alternisepala; filamenta brevia, basi incrassata et hic inter se connata; connectivum valde incrassatum; antherae introrsae, longitudinaliter dehiscentes; loculi paralleli. Ovarii rudimentum parvum evolutum, cum basi filamentorum connatum." In *Sphaerostylis* the stamens are said to be: "Stamina 3, alternisepala; filamenta fere nulla, in columnam connata; antherae in summa columna erectae, demum subreflexae, apiculatae; loculi introrsum contigui, paralleli, longitudinaliter dehiscentes. Ovarii rudimentum nullum." The presence of a pistillode, of course, is scarcely of significance in this tribe, because in the type-species of *Tragia* itself, *T. volubilis* L., the pistillode appears as: "Ovarii rudimentum nanum vel nullum" (see Pax & Hoffmann, op. cit., 48). In brief, since *Sphaerostylis* is based upon a plant from Madagascar, and the three species brought under *Tragiella* by Pax & Hoffmann range from South Africa to British East Africa, it may not be doubted that *Tragiella* is correctly treated as a synonym of *Sphaerostylis,* with which it agrees both in characters and in range. *Megistostigma,* which Pax & Hoffmann have reduced to *Sphaerostylis,* differs from this genus at least in respect to its range, to its more or less applanate ♂ perianths, to the entire lobes in its ♀ perianth. *Clavistylus,* which Pax & Hoffmann treat as a valid genus, with the note (op. cit., 104): "Genus certissime affine est *Cnesmonae,* sed non stimulosum; insuper differt disco ♂ evoluto, stylis foliisque peltatis," has much less to do with *Cnesmone* than with *Megistostigma.* Smith himself (in Meded. Dep. Landb. **10:** 517. 1910) remarks that *Clavistylus* shares with *Megistostigma* the unisexual inflorescence and the characteristic disc of the ♂ flower, together with the thick columnar style. The difference between these two genera, Smith concludes, is that *Clavistylus* has peltate leaves, appendaged anthers, a 3-partite ♀ calyx and a style connate more extensively toward the apex. None of these differences has generic significance, and the new species described in the present contribution, based upon the Wang collections from Yunnan, is intermediate in its characters between the type-species of both *Megistostigma* and *Clavistylus.* It might be suspected that Pax & Hoffmann have not fully grasped the distribution and the morphology of these genera. They assume that *Cnesmone* has no disc, which is not the case. They bring together two monotypic genera based upon species endemic, re-

spectively, in Madagascar and in Malaysia which is certainly unnecessary. In addition, they publish a new genus for three African species which are manifestly allied with the holotype of *Sphaerostylis*, and accept the validity of a Malaysian monotypic genus, *Clavistylus*, which cannot be extricated from *Megistostigma*. I incline to retain two genera which are undoubtedly allied, but are distinct by their ranges and details of morphology. These genera are: *Sphaerostylis* (Syn. nov.: *Tragiella*), which belongs to Eastern Africa, and *Megistostigma* (Syn. nov.: *Clavistylus*), which is endemic in Malaysia and S. W. China.

No material is available here of the three species of *Tragia* described for the flora of the Philippine Islands, *T. irritans* Merr., *T. luzoniensis* Merr. and *T. philippinensis* Merr., and it is impossible to place them on the basis of the descriptions. Pax & Hoffmann (op. cit., 108) treat *T. irritans* as *Pachystylidium hirsutum* (Bl.) Pax & Hoffm. var. *β irritans* (Merr.) Pax & Hoffm., and describe the anthers of the binomial as: "Sessiles, subhorizontales, dorsifixae, extrorsae," adding that the styles are: "In columnam crassam, late conicam connati." The peculiar position of the anthers would seem to be due to their being more or less versatile upon a very short filament, which accounts for their being seen at the same time as sessile, subhorizontal and extrorse. All these plants may as yet be found to fall within the generic limits of *Cnesmone*.

The holotypes must be seen to dispose of *Cnesmone subpeltata* Ridl., *Tragia laevis* Ridl. and *Cnesmone glabrata* Kurz. The ♀ flower of *C. subpeltata* is unknown (see Ridley in Kew Bull., 368. 1923, and Fl. Malay Penins. **3:** 307. 1924), but the note: "Anther-cells separated by a wide connective keeled on both sides and prolonged to a short point" fits the stamens of *Megistostigma malaccense* in so precise a manner as to suggest that Ridley's binomial is a synonym of that species. The leaves of *M. malaccense* are not essentially peltate or even subpeltate, but their venation is pinnately triplinerved, and this venation frequently yields subpeltate foliage in the Euphorbiaceae. *Tragia laevis* is said by Ridley (in Kew Bull., 368. 1923 and Fl. Malay Penins. **3:** 308. 1924) to have: "disc large circular papillose. Stamens 3, filaments short thick, as long as disc; anther cells 2 separated on a broad thick connective . . . style stout short with 3 fleshy arms with thick papillae on the upper face." These are certainly not the characters of a species of *Tragia* but I may not say whether *Cnesmone* or *Megistostigma* is involved. The key of Pax & Hoffmann (op. cit., 10) would point to the latter (as *Clavistylus*), which is supposedly distinct from *Cnesmone* on account of its having: "Discus ♂ evolutus." Unfortunately, the ♂ flower of certain species of *Cnesmone* has as large and as well formed an annulus as that of *Megistostigma*.

Pax & Hoffmann refer to *Cnesmone glabrata* Kurz as follows (op. cit., 103 *Nota 2*): "A nobis non visa et ab auctoribus omissa, verosimiliter a *C. javanica* vix diversa est." Ridley reduces it to *Megistostigma malaccense* (Ridley's *Sphaerostylis malaccensis*) on the strength of the description, but fails to effect the combination under *Sphaerostylis,* which is required by Art. 54 of the Rules of Nomenclature. Such a combination, *Sphaerostylis glabrata* (Kurz) Merr., is effected in the Papers Mich. Acad. Sc. Bot. **24:** 78. 1938, with *M. malaccense* in synonymy. Kurz's own description does not seem to bear out these dispositions. Kurz (in Flora **58:** 32. 1875) says: "Calycis laciniae lineari-oblongae, acuminatae, sparse puberulae, fimbriatae, 2 lin. circiter longae, subinde in dentem unum alterumve productae." Despite the added note: "Ovarium . . . stigmate glaberrimo magno campanulato-cuneato terminato," this description excludes *Megistostigma malaccense,* which (see Hook. Icon. **16:** *pl. 1592.* 1887) has entire calyx-lobes. *Cnesmone glabrata* is a *nomen dubium* on the face of the publication, which is to be rejected under the Rules (see Art. 63 and Rec. XXXVII) until such time as the holotype becomes available for certification.

The single species of *Plukenetia* endemic in eastern tropical Asia, *P. corniculata* Sm., is placed by Pax & Hoffmann (op. cit., 22) under *Pterococcus* Hassk., together with two other African endemics, *P. africanus* (Sond.) Pax & Hoffm. and *P. procumbens* (Prain) Pax & Hoffm. Still another genus, *Angostylidium* (Muell. Arg.) Pax & Hoffm., is used by the two authors (op. cit., 17) for *Plukenetia conophora* Muell. Arg., which ranges in tropical western Africa. It may be suspected that this arrangement is not free from the same misconceptions that have suggested the publication of *Tragiella* and the reduction of *Megistostigma* under *Sphaerostylis.* I cannot find characters to separate *Pterococcus* from *Plukenetia,* and agree more than readily with Pax & Hoffmann that *Angostylidium*: "A *Plukenetia* paulo distat." The winged ovary which Pax & Hoffmann (op. cit. 9–10) emphasize in their key to separate *Pterococcus* from *Plukenetia* occurs not only in both genera, but *Plukenetia volubilis* L., which is the *species lectotypica proposita* of the Linnean genus, has a capsule that has winged cocci like *Pterococcus.*

In conclusion, and so far as I know at the present, the PLUKENETIINAE of eastern tropical Asia are distributed as follows:

(1) — *Tragia* L. — The easternmost representative of the genus is said to be *T. novae-hollandiae* Muell. Arg., endemic in Australia, which I have not seen. *Tragia Delpyana* Gagnep. is represented in our herbarium by collections made in Laos and in the Valley of the Mekong,

in French Indo-China. In India proper several species are known, one of which, *T. involucrata* L., appears to be the parent-form of several lesser segregates. In the anthers of *T. involucrata* the connective tends to be thicker than is usual in the genus, and the dehiscence may be introrse. However, *T. bicolor* Miq., which is near *T. involucrata* and like it is endemic in India, has thin filaments and small anthers that dehisce laterally and have no appendages. It seems well established that the Indian species are closely related to those of Africa. *Tragia,* consequently, enters the flora of tropical Asia to a small extent, as an overflow, as it were, of the large African complex under the genus.

(2) — *Cnesmone* Bl. (*Cenesmon* Gagnep., Syn. Nov.; *Tragia* auct. Non L.) — The great majority of the Euphorbiaceae of the Tribe PLUKENETIINAE endemic in tropical Asia and Malaysia belong to this genus. Technically, the anthers' structure, involving the presence of an appendage between the cells, is the generic character. The range extends from Yunnan, in S. W. China, to Malaysia.

(3) — *Megistostigma* Hook f. (*Clavistylus* J. J. Sm., Syn. nov.; *Spaerostylis* auct. Non Baill.; ? *Tragia* auct. Non L.; ? *Cnesmone* auct. Non Bl.) — Close to *Sphaerostylis* Baill. (*Tragiella* Pax & Hoffm., Syn. nov.), which differs in range (Madagascar, east tropical Africa) and in structural details of the perianth, lobes and anthers. Reported, so far, in S. W. China (*M. yunnanense* Croiz. sp. nov.), in Malaya proper (*M. malaccense* Hook f.) and in the Sunda (*M. peltatum* (J. J. Sm.) Croiz. comb. nov.).

(4) — *Plukenetia* L. (*Pterococcus* Hassk.) — A nearly pandemic genus of less than 12 species ranging from America to eastern Asia through tropical Africa. Represented in Asia by one widespread species, *P. corniculata* Sm., with distribution N. E. India to eastern Malaysia.

These four genera can be keyed as follows:

Anthers numerous, fruit more or less winged. ..... *Plukenetia* L.

Anthers (2–)3, fruit not winged.

Filaments not forming an appendage beyond the anthers, usually thin; styles spreading. ..... *Tragia* L.

Filaments forming an appendage beyond the anthers, thick.

Stamens more or less triangular, apically dehiscing by a slit; styles thickened, more or less extensively connate or fused. ..... *Megistostigma* Hook. f.

Stamens ligulate to subclavate, with a manifest connective between the anther-cells, dehiscing laterally or introrsely; styles free or weakly connate. ..... *Cnesmone* Bl.

Plukenetia L.

Plukenetia corniculata Sm. in Nov. Act. Upsal. **6**: 4. 1799; Muell. Arg. in DC. Prodr. **15**[2]: 772. 1866; Hook. f., Fl. Brit. Ind. **5**: 464. 1887; J. J. Sm. in Meded. Dept. Landb. **10**: 526. 1910; Merr. in Philip. Jour. Sc. **16**: 564. 1920, Enum. Philip. Fl. Pl. **2**: 447. 1923.

Pterococcus corniculatus (Sm.) Pax & Hoffm. in Pflanzenr. 68 [IV. **147**. IX–XI]: *22*. 1919; Merr. in Papers Mich. Acad. Sc. **24**: 78. 1938.

Pterococcus glaberrimus Hassk. in Flora **25**, Beibl. 41, *2*: 41. 1842; Ridl., Fl. Malay Penins. **3**: 309. 1924.

SPECIMENS SEEN:[1] *Rahmat Si Boeea 7593* & *7827*, east coast of Sumatra, 1935.

As noticed by Mansfeld (Kew Bull. 454. 1935) and by Merrill, *Pterococcus* Hassk. (1842) is a later homonym of *Pterococcus* Pallas (1776). Hasskarl's name is not worthy of being proposed as a *nomen conservandum*. The material seen strongly suggests at first sight a subherbaceous form of *Acalypha* L. The ♂ perianth is 4-partite, small, and has many stamens.

Tragia L.

Tragia Delpyana Gagnep. in Bull. Soc. Bot. France **71**: 1027. 1924, in Lecomte, Fl. Gén. Indo-Ch. **5**: 393. 1926.

SPECIMENS SEEN: *Thorel 2205*, Laos [isotype]; *Pierre* s.n., Cochinchina [isosyntype]; *Harmand*, delta of the Mekong.

This is the only authentic species of *Tragia* known to me east of India. The two subsessile stamens are very characteristic.

Megistostigma Hook f.

Megistostigma malaccense Hook. f. in Icon. **16**: *pl. 1592*. 1887, Fl. Brit. Ind. **5**: 467. 1888.

Sphaerostylis malaccensis Pax & Hoffm. in Pflanzenr. 68 [IV. **147**. IX–XI]: 31, *fig. 11 E, F*–107. 1919; Ridl. Fl. Malay Penins. **3**: 308. 1924.

Sphaerostylis glabrata Merr. in Papers Mich. Acad. Sc. Bot., **24**: 78. 1938 [*quoad specimina Sumatrana. An: Cnesmone glabrata Kurz* ?].

SPECIMENS SEEN: *Rahmat Si Boeea 7186, 8780, 9864*, east coast of Sumatra, 1935; *Rahmat Si Toroes 1389*, east coast of Sumatra, 1928.

Hooker's type-illustration is good, although the anthers it shows are

[1]All the specimens cited belong to the herbarium of the Arnold Arboretum of Harvard University.

apparently immature. The species is very easily confused at first sight with a narrow-leaved form of *Mallotus* or *Macaranga*.

Megistostigma peltatum (J. J. Sm.) Croiz. comb. nov.

Clavistylus peltatus J. J. Sm. in Meded. Dept. Landb. **10**: 517. 1910; Koord., Excurs. Fl. Java **2**: 498. 1912; van Steen. in Bull. Jard. Bot. Buitenz. iii. **12**: 201, *fig. 10*. 1932; Pax & Hoffm. in Pflanzenr. 68 [IV. **147**. IX–XI]: 104. 1919.

I have not seen specimens, but the illustrations and the careful critical notes of van Steenis, together with the descriptions and the remarks of Smith and Pax & Hoffmann, leave no doubt as to the true position of *Clavistylus*. As previously stated, *M. yunnanense* has characters which are intermediates between those of *M. malaccense* and *M. peltatum*.

Megistostigma cordatum Merr. in Philip. Jour. Sc. **16**: 563. 1920, Enum. Philip. Fl. Pl. **2**: 446. 1923.

I have seen no material of this species. The description points to a peculiar form for the genus, as it speaks of: "Style pubescent, 2 to 3 mm. long; stigma subglobose, obscurely 3-lobed, glabrous, fleshy, about 6 mm. in diameter."

Megistostigma yunnanense Croiz. sp. nov.

Frutex scandens, primo intuito *Phaseoli* vel *Dolichi* specimen, ni folia obstarent simplicia, habitu optime mentiens. Caulibus teretibus, striatis, pallidis, sublignosis, sub apicem parcius setulosis, stipulis triangulari-lanceolatis ad 1 cm. longis, brunneis, integris, conspicuis ad basem petiolorum insignitis. Foliis cordatis, plus minusve ellipticis vel obovatis, breviter abrupteque caudatis, integerrimis, nervis utrinque 3–4 adscendentibus, pilis adpressis simplicibus hinc inde obsitis, lamina caeterum glabrescente vel glabra, 12–16 cm. longa, 7–14 cm. lata, [laminis interdum minimis 5 cm. longis, 2 cm. latis], petiolo herbaceo, eglanduloso, sat gracili, parcius pubescente, 4–14 cm. longo. Floribus in cymulis 2-sexualibus congregatis [an semper ?], ♂ ca. 7 mm. magnis, perianthio fere ad basem in lobos 3 integros, triangulares, eglandulosos partito, lobis ca. 3 mm. magnis; staminibus 3, triangularibus, carnosulis, processo in medio breviter producto, rima apicaliter dehiscentibus, ca. 1 mm. longis, 1.5 mm. latis, in stipite brevissime insidentibus, more generis annulo haud carnoso, nempe perianthio ipso grosse plicato-rugoso, circumdatis, pistillodio nullo [an semper ?]. Floribus ♀ in axillis bractearum foliaceo-subpetaloides latiusculis orientibus, perianthio in lobos 5 partito, 6 mm. longos, 2 mm. latos, integerrimos, lanceolato-

ovatos, petaloideos, venosos; ovario depresso-globuloso, albicante hispidulo, ca. 2 mm. magno, stylis in columnam coalitis, apice subimpresso-partitis [sic immaturis tantum ?], grosse clavatis, glaberrimis, 5 mm. longis, 4 mm. latis. Caetera desiderantur.

YUNNAN: *Wang 75870,* Sheau-meng-yeang, Cheli, alt. 1100 m., "vine on mountain slope, woods," Sept. 1936 [♂ spec. — *Holotypus*]; *Wang 74861,* Fo-Hai, alt. 1300 m., "in woods," June 1936 [♀ spec.].

The anthers perfectly match those shown by van Steenis in *M. peltatum* (*Clavistylus peltatus*). In every detail of its gross morphology but the simple leaves, the new species simulates vines of the Leguminosae family. The genus is new for the flora of China, and is likely to turn up in Indochina, where so far it has not been recorded.

Cnesmone Bl.

Cnesmone javanica Bl., Bijdr. **12:** 630. 1825 [as *Cnesmosa,* sphalm.]; Bl. & Fisch., Fl. Jav. **1:** vi *in nota* [Blume emend., *Cnesmone*]; Baill. Et. Gén. Euphorb. 458, *pl. 4, fig. 14–17.* 1858; Muell. Arg. in DC. Prodr. **15**[*2*]**:** 926. 1866; J. J. Sm. in Meded. Dept. Landb. **10:** 513. 1910; Pax & Hoffm. in Pflanzenr. 68 [IV. **147.** IX–XI]: 102. 1919; Ridl., Fl. Malay Penins. **3:** 306. 1924; Gagnep. in Lecomte, Fl. Gén. Indo-Ch. **5:** 385. 1926; Merr. in Univ. Calif. Publ. Bot., **15:** 161. 1929.

SPECIMENS SEEN: *J. D. H. & T. T.,* Khasia; *Pierre,* Indochina; *For. Res. Inst. Dehra Dun 15094,* Burma; *Elmer 20663,* Borneo; *Brinkman 658,* Java.

This species is hardly better understood today than it was one century ago. Ridley published *C. subpeltata* which, as previously noticed, cannot be identified from description and may be merely a leaf-form of Blume's species. The material seen from Khasia is very close to *C. tonkinensis,* a specimen of which, *Balansa 3259* [fragm. in herb. Arnold Arb.], has been determined by Pax & Hoffmann (op. cit., 102) as *C. javanica.* The ♀ perianth is 6-lobed in *C. tonkinensis* and *C. anisosepala* and 3-lobed in *C. javanica.* However, three of the lobes of the perianth of the species first mentioned are much smaller than the others with which they alternate, and it seems altogether likely that the typic 3-lobed perianth of *C. javanica* is derived from the 6-lobed perianth of *C. tonkinensis* and *C. anisosepala* by abortion of the inner floral whorl [= petals]. On the cited *Pierre* specimen, which I may not dissect, there is one ♀ perianth in which the relic of a lobule would seem to appear between two normally developed lobes.

Cnesmone laotica (Gagnep.) Croiz. comb. nov.

Cenesmon laoticum Gagnep. in Bull. Soc. Bot. France **71**: 867. 1924, in Lecomte, Fl. Gén. Indo-Chin. **5**: 390. 1926.

SPECIMENS SEEN: *Thorel; Harmand* [Godefroy], Indochina.

Gagnepain describes six sepals in the perianth of this species, three of which are much smaller. Better collection may prove that *C. laotica* falls within the specific limits of *C. tonkinensis* or *C. anisosepala*.

Cnesmone linearis (Gagnep.) Croiz. comb. nov.

Cenesmon lineare Gagnep. in Bull. Soc. Bot. France **71**: 867. 1924; in Lecomte, Fl. Gén. Indo-Chin. **5**: 389. 1926.

SPECIMENS SEEN: *Thorel*, Indochina.

This, too, may prove to be an extreme form of the *C. tonkinensis* - *C. anisosepala* complex, with very narrow leaves.

Cnesmone peltata (Gagnep.) Croiz. comb. nov.

Cenesmon peltatum Gagnep. in Bull. Soc. Bot. France **71**: 868. 1924; in Lecomte, Fl. Gén. Indo-Chin. **5**: 392. 1926.

SPECIMENS SEEN: *Poilane 5493* & *8349*, Indochina.

Poilane 8349 has a gross morphology that is strongly reminiscent of *Megistostigma*, and this is probably the material that has prompted Gagnepain (in Bull. Soc. Bot. France **71**: 866. 1924) to remark that one of the species of *Cenesmon* is close to *Clavistylus*. The holotype of the species, *Poilane 5493*, however, does not suggest *Clavistylus* and agrees with the gross morphology of *Cnesmone*. I may not say whether these differences are merely the result of individual variations, because the material I have at hand is sterile. Gagnepain's description of the flowers points to *Cnesmone*, witness the characterization of the style as having: "Stigmata 3, lanceolata, valde patentia, tenuia, 3 mm. longa, 1.5 mm. lata, supra papillis conicis majusculis marginantibus tecta."

Cnesmone Poilanei (Gagnep.) Croiz. comb. nov.

Cenesmon Poilanei Gagnep. in Bull. Soc. Bot. France **71**: 869. 1924; in Lecomte, Fl. Gén. Indo-Chin. **5**: 387. 1926.

SPECIMEN SEEN: *Poilane 2862*, Indochina.

The anthers are those of *Cnesmone*. Although near to small-leaved forms of *C. javanica* and *C. tonkinensis*, this species is likely to prove distinct. The *locus classicus* is the Island of Tré, near Nhatrang, Annam, which is rich in peculiar endemics characterized by small, often distinctly sclerophyllous types of foliage.

Cnesmone tonkinensis (Gagnep.) Croiz. comb. nov.

Cenesmon tonkinense Gagnep. in Bull. Soc. Bot. France **71**: 869. 1924; in Lecomte, Fl. Gén. Indo-Chin. **5**: 389. 1926.

SPECIMENS SEEN: *Bon 5810,* Indochina; *Balansa 3259,* Indochina; *Pételot 6520* & *6521,* Indochina.

It is difficult to distinguish at sight this species from *C. javanica,* which it matches in every detail of its gross morphology. The ♀ perianth has six lobes, three of which are much smaller. In *C. javanica* the ♀ perianth has only three lobes, suggesting a reduction from the perianth of *C. tonkinensis.* It is probable that intermediates between these two species will be found, with three subabortive lobes. Good material is needed which is now not available.

Cnesmone Mairei (Léveillé) Croiz. comb. nov.

Alchornea Mairei Léveillé Catal. Pl. Yun-nan 94. 1916.

SPECIMEN SEEN: *Maire* s.n., Yunnan.

The nomenclature of this species is altogether confusing. Léveillé published it under *Alchornea* in 1916, basing it upon an unnumbered collection of Maire from the "Vallon de You-fong-kéou" in Yunnan. Handel-Mazzetti mistakenly identified Maire's material as a variety of *Tragia involucrata* L. (Symb. Sin. **7**: 218. 1931), which is a very different plant. Rehder accepted Handel-Mazzetti's misdetermination at first (in Jour. Arnold Arb. **14**: 234. 1933), but later decided it was a distinct species and effected the combination *Tragia Mairei* (Léveillé) Rehd. (in Jour. Arnold Arb. **18**: 214. 1937). While this was going on, Gagnepain found the Maire collection still unnamed in the Paris herbarium and based upon it *Cenesmon Mairei* Gagnep. (in Bull. Soc. Bot. France **71**: 868. 1924; in Lecomte, Fl. Gén. Indo-Chin. **5**: 391. 1926). Thus the same collection was independently used to publish a species under *Alchornea* and under *Cenesmon,* the same specific epithet being chosen by coincidence by Léveillé and by Gagnepain. A good fragment of the holotype of Gagnepain's binomial is in our herbarium. I have dissected its flowers and I am certain that *Cnesmone* and not *Tragia* is involved. The ♂ perianth has the very conspicuous annulus that is mistakenly believed to be characteristic of the flower of *Megistostigma* and not of that of *Cnesmone.*

Cnesmone anisosepala (Merr. & Chun) Croiz. comb. nov.

Tragia anisosepala Merr. & Chun in Sunyatsenia **2**: 261. 1935.
Tragia involucrata Merr. [*fide ipsius*] in Lingn. Jour. Sci. **5**: 111. 1927. Non L.

SPECIMEN SEEN: *Lau 141,* Hainan.

The connective between the anther-cells is well-developed and the annulus is manifest. Further critical comparison with *C. tonkinensis* is desirable.

Cnesmone hainanensis (Merr. & Chun) Croiz. comb. nov.

Cenesmon hainanense Merr. & Chun in Sunyatsenia **5**: 94. 1940.

SPECIMEN SEEN: *How 73926*, Hainan.

The ♂ flowers are lacking, but the holotype, which is the single collection so far known, suggests *Cnesmone*, and it is quite unlikely that it may prove to belong to *Tragia*. As remarked in the original publication, *C. hainanensis* resembles *Poilane 5493*, holotype of *C. peltata*. The true affinities of this interesting species are still obscure.

Sphaerostylis Baill.

To dispose of the troublesome synonymy created by the reduction of *Megistostigma* to *Sphaerostylis*, and to reestablish the limits in this group of genera, the following new combinations and listings are required:

Sphaerostylis natalensis (Sond.) Croiz. comb. nov.

Tragia natalensis Sond. in Linnaea **23**: 107. 1850; Muell. Arg. in DC. Prodr. **15**[2]: 942. 1866; Prain in Dyer, Fl. Trop. Afr. **6**[1]: 974. 1913.

Tragiella natalensis (Sond.) Pax & Hoffm. in Pflanzenr. 68 [IV. **147**. IX–XI]: 105, *fig. 24, A–E*. 1919.

Sphaerostylis anomala (Prain) Croiz. comb. nov.

Tragia anomala Prain in Kew Bull. 194. 1912; in Dyer, Fl. Trop. Afr. **6**[1]: 975. 1913.

Tragiella anomala (Prain) Pax & Hoffm. in Pflanzenr. 68 [IV. **147**. IX–XI]: 106, *fig. 24, F*. 1919.

Sphaerostylis Frieseana (Prain) Croiz. comb. nov.

Tragia Frieseana Prain in Wissensch. Ergeb. Schwed. Rhodesia-Kongo Exped. 125. 1914.

Tragiella Frieseana (Prain) Pax & Hoffm. in Pflanzenr. 68 [IV. **147**. IX–XI]: 106. 1919.

Prain has reduced *Sphaerostylis* to *Tragia*, apparently granting to Baillon's genus a subgeneric or sectional rank (in Dyer, Fl. Trop. Afr. **6**[1]: 976. 1913) under the cryptic listing: "*Tragia* (*Sphaerostylis*) *Tulasneana*." I cannot follow him, because the concept of generic limits he adopts in this tribe would tend to bring all its genera under *Tragia*.

Ramelia Baill.

Ramelia codonostylis Baill. in Adans. **11**: 132. 1874; Benth. in Benth. & Hook. Gen. Plant. **3**: 326. 1880; Guillaum. in Lecomte Not. Syst. **2**: 376. 1913; in Arch. Bot. Caen **2**[3]: 40. 1929; Pax & Hoffm. in Pflanzenr. 68 [IV. **147**. IX–XI]: 108. 1919.

I have not seen material of this rare shrub, which is strictly localized in New Caledonia, and, according to Guillaumin, is synonymous with *Cleidion platystygma* Schlecht. (in Bot. Jahrb. **39**: 150. 1907). The lobes of the ♀ calyx form two series, as in *Cnesmone*, but the habit is not that of a climber. *Ramelia*, consequently, is not the same genus as *Cnesmone* or *Megistostigma*. Its phylogenetic significance is still unknown, and it may prove to be an ancestral form to both *Sphaerostylis* and *Megistostigma*. It is certainly a very primitive form.

Arnold Arboretum,
Harvard University.

THE COMPARATIVE MORPHOLOGY OF THE ICACINACEAE III. IMPERFORATE TRACHEARY ELEMENTS AND XYLEM PARENCHYMA

I. W. BAILEY AND R. A. HOWARD

With three plates

WE HAVE shown in the second paper of this series (3) that there are salient irreversible trends of structural specialization in the vessels of the Icacinaceae which parallel those that occur in other families of the dicotyledons. These lines of phylogenetic modification are more or less closely synchronized and may be utilized in differentiating the Icacinoideae into successive levels of increasing structural modification.

Bailey and Tupper (2) and Kribs (6) have demonstrated by statistical analyses of the dicotyledons as a whole that there are clearly defined trends of evolutionary changes in the imperforate tracheary elements and the wood parenchyma of the secondary xylem. Although these cells tend in general to become more and more extensively modified with increasing specialization of the cambium and vessels, the rates of the various phylogenetic changes are not the same in all cases. Thus, in a specific family, the modification of the imperforate tracheary elements or of the wood parenchyma may run ahead of or lag behind that of the vessels. It is of interest, accordingly, to study the types of imperforate tracheary elements and of xylem parenchyma that occur in the three major categories of the Icacinoideae which were differentiated in the second paper of this series.

IMPERFORATE TRACHEARY ELEMENTS

The length of the vessel members in the secondary xylem of dicotyledons is determined primarily by the length of the fusiform initials in the cambium. The elongation or contraction of the vessel members during tissue differentiation is so slight in most cases as to be statistically negligible, Bailey (1). On the contrary, the diameters and the cross-sectional area of the vessels are determined largely by the lateral expansion of the vessel members during tissue differentiation. The imperforate tracheary elements of the secondary xylem commonly elongate

more or less during tissue differentiation and, therefore, tend to be considerably longer than the vessel members and than the cambial initials from which they are both derived. The tangential diameters of the imperforate tracheary cells are determined largely by the cambial initials. Therefore, conspicuous fluctuations in the cross-sectional area of imperforate tracheary elements are commonly correlated with variations in the size of the fusiform initials of the cambium.

As we have shown in the preceding paper of this series and as is indicated in Table I, there is a progressive shortening of the vessel members and pari passu of the fusiform initials of the cambium with increasing structural specialization of the vessels in the Icacinoideae. If the amount of elongation of the imperforate tracheary elements were the same in all cases, the phylogenetic shortening of the vessel members would of necessity be closely paralleled by a concomitant decrease in length of the imperforate elements. It is evident, however, from the measurements listed in Table I that the elongation of these cells varies in different categories of the Icacinoideae.

TABLE I

MEASUREMENTS IN MICRONS

Categories of Icacinoideae	Average length cambial initials vessel members	Average length imperforate tracheary cells	Average Elongation imperforate tracheary cells
I. Trilacunar Icacineae: scalariform	1470	2490	1020
II. Trilacunar Icacineae: scalariform-porous	1050	2580	1530
III. A. Unilacunar Icacineae: porous	590	1600	1010
III. B-D. Iodeae, Sarcostigmateae, Phytocreneae: porous	470	870	400

In the group II Icacinoideae, the imperforate tracheary elements are on an average slightly longer than those of Group I. This is due to the fact that, although the cambial initials of Group II are conspicuously shorter than those of Group I, the imperforate tracheary elements elongate more extensively during tissue differentiation. In Group IIIA, the

elongation of these elements is comparable to that in Group I, but the cells are much shorter owing to excessive decrease in the length of the cambial initials. In Group IIIB-D, the imperforate tracheary elements are very short due not only to a further decrease in the length of the cambial initials but also to a reduced elongation during tissue differentiation. It is evident, accordingly, that in the Icacinaceae, as in certain other families of dicotyledons, the specialization of the vessels must be of considerable magnitude before a statistically significant shortening of the imperforate tracheary elements becomes evident.

Although the imperforate tracheary elements of the Group II Icacinoideae are as long and have as large a cross-sectional area as the tracheids of Group I, they commonly exhibit a conspicuous reduction in the size of their bordered pits and in the volume of their lumina. In such genera of the Group I Icacinoideae as *Anisomallon, Apodytes, Calatola, Cassinopsis, Dendrobangia, Emmotum, Oecopetalum, Pittosporopsis, Platea, Poraqueiba,* and *Citronella,* the inter-tracheid bordered pits commonly attain maximal diameters of from 4–5μ in the first-formed secondary xylem and from 6–8μ in the later-formed wood. These pits have clearly defined borders in surface view and large conspicuous chambers in sectional view, *Figs. 1 & 2.* In the Group II Icacinoideae, bordered pits of comparable dimensions occur in certain species of *Stemonurus* and *Cantleya,* but less commonly, if ever, in *Discophora, Gastrolepis, Grisollea, Gonocaryum, Lasianthera, Leptaulus, Medusanthera,* and *Urandra.* In the latter genera, not only are the borders of the pits more or less reduced in diameter, *Fig. 3,* but also the pit chambers frequently are flattened and thus are difficult to detect in sectional views of the bordered pits.

In the Group I Icacinoideae, the walls of the tracheids fluctuate from relatively thin in *Platea, Fig. 1,* to very thick in *Apodytes, Emmotum, Fig. 2, Ottoschulzia* and certain species of *Citronella.* In the Group II Icacinoideae, with the exception of *Gonocaryum* and of certain species of *Leptaulus* and *Stemonurus,* the lumina of the imperforate tracheary elements are much reduced in volume or are occluded by excessive thickening of the secondary walls, *Fig. 3.*

In the Group IIIA, in contrast to the Group I, Icacinoideae, the imperforate tracheary elements of the arborescent and non-scandent frutescent species exhibit not only a marked decrease in length and in cross-sectional area, *Fig. 4,* but also a conspicuous reduction in size of the bordered pits. The latter trend of specialization is, however, less advanced in *Merrilliodendron* than in *Desmostachys* and *Alsodeiopsis* and particularly than in *Mappia* and *Nothapodytes.* In the last two

genera, the bordered pits have been reduced to simple ones and the transition to libriform fibers is complete, *Fig. 4.* On the contrary, in those representatives of the unilacunar Icacineae having a scrambling or climbing habit of growth, as in the scandent Iodeae, Sarcostigmateae and Phytocreneae, there are reversals in the specialization of the imperforate tracheary elements which culminate in the formation of curious short tracheids. These tracheary cells are characterized by having relatively conspicuous lumina and numerous large bordered pits. They are most typically developed in the large-vesselled anomalous wood of *Pleurisanthes, Lavigeria* and of various representatives of the Iodeae and Phytocreneae. Intermediate or transitional stages of their phylogenetic differentiation occur in *Humirianthera, Icacina, Leretia, Rhaphiostylis, Mappianthus* and *Sarcostigma,* as well as in the denser, smaller-vesselled parts of the stems of certain Iodeae and Phytocreneae.

WOOD PARENCHYMA

The terminology of wood parenchyma distribution has been and still is somewhat confused and unsatisfactory, and ultimately will have to be revised and clarified. Although a comprehensive revision should not be attempted until more adequate data are available, certain recently proposed modifications of the terminology should be discussed at this time.

There are obviously two fundamentally different categories of wood parenchyma distribution. In the first of these, the distribution bears no specific relationship to the vessels, i.e. contacts between parenchyma and vessels are random and indefinite. On the contrary, in the second type, the parenchyma is definitely aggregated about the vessels. Chalk's (4) suggestion that these two major categories be designated respectively as *apotracheal* and *paratracheal* is, therefore, deserving of careful consideration. Chowdhury (5) has advocated the term, initial, for use in contrast to terminal, and Kribs (6) has proposed two additional terms, diffuse-aggregate and banded paratracheal. If these suggestions were generally adopted, the following classification of types of parenchyma distribution would result:

Apotracheal	**Paratracheal**
diffuse	scanty paratracheal
diffuse-aggregate	banded paratracheal
metatracheal	confluent
terminal	aliform
initial	vasicentric

Such a classification, however, is open to criticism from various angles. The term, metatracheal, was originally used by Sanio (7) for types of distribution in which the vessels are linked together by parenchyma. To use this term for designating an apotracheal type of distribution reverses the original meaning and it appears desirable to replace it by *banded apotracheal*. To make diffuse-aggregate of coordinate rank with diffuse and to confine the use of the latter term to woods in which the wood parenchyma strands are completely isolated from one another is both unnecessary and unwise; woods are classified as diffuse porous regardless of whether the individual vessels are isolated or occur in small clusters. Diffuse-aggregate or preferably *diffuse-in-aggregates* should be used in designating one of several possible sub-divisions of diffuse. In the case of tropical woods, there frequently is considerable difficulty in differentiating banded apotracheal from terminal. The introduction of the term, initial, further complicates the difficulty. Terminal has been utilized from a descriptive or topographical point of view for parenchyma situated at or upon the margins of growth layers, regardless of whether it differentiates at the end or the beginning of a growing season. To interject a purely ontogenetic point of view at this time is inadvisable.

Kribs' (6) statistical investigations have demonstrated that the primitive type of parenchyma distribution in dicotyledons is diffuse and that the aggregation of parenchyma in apotracheal bands and in paratracheal patterns involve varying degrees of phylogenetic specialization. It should be emphasized in this connection, however, that the statistical data do not enable one to determine with certainty how the various paratracheal types have arisen from the apotracheal ones. This can be accomplished only by intensive investigations of a wide range of families. Recent unpublished investigations of this character indicate that (1) broad-banded apotracheal types arise from diffuse ones through various transitional narrow-banded apotracheal types, (2) in many families, vasicentric, aliform and confluent types originate from banded types, and (3) through excessive reduction, scanty paratracheal types may arise at various levels of the differentiation of both apotracheal and paratracheal types. Furthermore, these investigations indicate that there are many complex types of parenchyma distribution which are transitional between typical apotracheal and purely paratracheal types. These distributional patterns are so diverse and variable, not only in related genera and species but also within the limits of a single individual, that it seems unwise to develop a fixed and stereotyped terminology for their description.

In view of such facts as these, we propose to use the following simplified basic terminology:

Apotracheal (Chalk)	**Paratracheal** (Sanio)
diffuse	scanty
banded	abundant
terminal	abaxial
	vasicentric

The more complex transitional types of distribution will be referred to as such. For example, banded paratracheal will be regarded as a mixture of banded apotracheal and paratracheal just as diffuse may be associated with paratracheal, terminal with vasicentric, etc. Confluent and aliform will likewise be regarded as transitional or mixed types. Furthermore, the definition of confluent either should be revised or the term should be used in a purely descriptive sense without implication of origin from coalesced aliform.

The distribution of the wood parenchyma in the Group I Icacinoideae is dominantly of the primitive diffuse apotracheal type, *Fig. 5*. The parenchyma is abundant and tends to occur in small linear aggregates of varying sizes, forms and orientations.[1] Where the parenchyma is reduced in amount, as in the small stems of certain herbarium specimens, there is at times a higher ratio of contacts between parenchyma and vessels than can be accounted for upon the basis of a purely random distribution of the parenchymatous elements. This tendency is much exaggerated in the wood of *Emmotum holosericeum* Ducke and certain exceptional species of *Citronella,* where the distribution is obviously transitional to scanty paratracheal and much of the parenchyma tends to be in contact with the abaxial surfaces of the vessels. In *Poraqueiba, Fig. 6,* and particularly in *Ottoschulzia,* there frequently are indications of transitions from diffuse (in tangentially linear aggregates) to narrow-banded apotracheal.

The distribution of wood parenchyma in the Group II Icacinoideae is transitional and highly variable. In *Stemonurus, Discophora* and *Gonocaryum,* the parenchyma is abundant and tends to be transitional between diffuse (in tangentially linear aggregates) and narrow banded apotracheal.[2] In *Medusanthera,* the parenchyma is transitional between these types of distribution and more or less irregularly banded types in

[1]For additional illustrations of these types of parenchyma distribution, the reader is referred to *Figs. 1–3* of the preceding paper of this series, Bailey & Howard (3).

[2]See *Fig. 6* of the preceding paper of this series.

which the vessels are partly or completely jacketed by parenchyma, *Fig. 9.* In *Cantleya*[3], *Gastrolepis* and *Urandra*[4], the parenchyma is scanty paratracheal, but exhibits vestiges of its derivation from apotracheal, *Fig. 10.* In the wood of *Leptaulus daphnoides* Benth., the distribution is transitional from diffuse to very scanty paratracheal, and the parenchyma tends to occur in contact with the abaxial surfaces of the vessels, *Fig. 11.* In small stems from herbarium specimens of *L. grandifolius* Engl., *L. Zenkeri* Engl., and *Grisollea Thomassetii* Hemsl., there are conspicuous arcs of aggregated vessels and parenchyma in the first-formed secondary xylem. However, this is not indicative necessarily of a similar distribution in the later-formed wood. Aberrant distributions of vessels and parenchyma are of not infrequent occurrence in young stems, particularly where growth is excentric or where tropistically induced arcs of gelatinous fibers are formed.

The wood parenchyma of the Group III Icacinoideae occurs in varying mixtures of apotracheal and paratracheal types of distribution and the ratios of the two types fluctuate greatly not only in different genera and species but also in different parts of the same plant. *Merrilliodendron* is characterized by having very abundant apotracheal parenchyma, *Fig. 7.* It is transitional between diffuse (in tangentially linear aggregates) and narrow-banded apotracheal and occurs in association with paratracheal parenchyma which encloses the vessels, viz., vasicentric. Similar distributions of apotracheal parenchyma occur in certain representatives of *Nothapodytes,* whereas in others, as in *Mappia, Fig. 14,* and *Alsodeiopsis, Fig. 8,* the distribution is of a more or less irregular banded apotracheal type. In these plants, the associated paratracheal parenchyma fluctuates between scanty and vasicentric. It should be noted in this connection, however, that there are certain species of *Nothapodytes,* e.g. *N. dimorpha* (Craib) Sleumer and *N. pittosporoides* (Oliv.) Sleumer, which are structurally divergent. Twigs from herbarium specimens of these plants are characterized by having fairly conspicuous growth layers and small vessels in relatively large irregular clusters. The vessels have conspicuous spiral thickenings and the parenchyma is much reduced in amount, occurring as fragments of bands and as scattered isolated cells.

In our material of *Desmostachys, Fig. 12,* and of those unilacunar Icacineae which have a scrambling or climbing habit of growth, viz., *Icacina, Humirianthera, Lavigeria, Leretia, Pleurisanthes, Fig. 15, Rhyticaryum* and *Rhaphiostylis, Fig. 13,* there is a more or less con-

[3]See *Fig. 4* of the preceding paper of this series.

[4]See *Fig. 7* of the preceding paper of this series.

spicuous reduction in the amount of banded apotracheal parenchyma. The associated paratracheal parenchyma tends to persist as the apotracheal is reduced, and thus there are varied transitions between mixed banded apotracheal and paratracheal types of distribution and others having a prevailingly paratracheal or vasicentric distribution. Such fluctuations are of common occurrence in different parts of the same plant, and it is difficult to characterize species or genera by specific types of parenchyma distribution. As the banded apotracheal parenchyma is reduced in amount, it tends to be replaced by shorter and shorter arcs of parenchyma, varying ratios of which are closely associated with the vessels. Under the latter circumstances, the paratracheal parenchyma appears to have winglike or aliform extensions, *Figs. 12 & 13.* This is true regardless of whether the vessels are completely jacketed by paratracheal parenchyma or not.

Similar unstable types of parenchyma distribution occur in the less specialized, small-vesselled parts of the stems of certain representatives of the Phytocreneae and the Iodeae, e.g. *Mappianthus, Hosiea sinense* (Oliv.) Hemsl. & Wils., *Iodes liberica* Stapf, etc. In the large-vesselled anomalous wood of these plants, as also of *Pleurisanthes* and *Lavigeria*, the parenchyma tends to be more dominantly paratracheal, *Fig. 16*, and occurs in association with much modified vestiges of banded apotracheal. In *Sarcostigma* and at times in certain of the Phytocreneae, the strands of wood parenchyma tend to be replaced by curious septate fusiform parenchymatous elements; true septate fibers do not occur in the secondary xylem of the Icacinoideae.

It should be noted, in connection with our discussion of wood parenchyma, that the length of parenchyma strands and of fusiform parenchymatous elements is determined by the length of the fusiform initials of the cambium. Therefore the reductions in the length of the vessel members and of the cambial initials in the Group II and Group III Icacinoideae are closely paralleled by concomitant reductions in the length of the parenchymatous elements.

SUMMARY AND CONCLUSIONS

The data presented in the preceding pages indicate that there are salient trends of morphological specialization in the imperforate tracheary elements and the wood parenchyma of the Icacinoideae which tend in general to parallel those that occur in the vessels. Although the phylogenetic modifications of these three categories of cells are not perfectly synchronized in all cases, the differentiation of the Icacinoideae into three Groups, upon the basis of differences in vessel structure,

serves to segregate the imperforate tracheary elements and the wood parenchyma into three general levels of increasing morphological specialization.

In our Group I Icacinoideae, as in many other genera of structurally less modified dicotyledons, the primitive types of vessels occur in association with typical large, more or less thick-walled tracheids. In the Group II Icacinoideae, the imperforate tracheary elements do not exhibit a reduction in length owing to their excessive elongation during tissue differentiation, but do show a conspicuous tendency towards reduction in size of their bordered pits and towards a much exaggerated thickening of their secondary walls. In other words, the imperforate tracheary elements of this group exhibit evidences of a transition from tracheids to fiber-tracheids. In the non-scandent representatives of the Group IIIA Icacinoideae, the imperforate tracheary elements show not only a conspicuous reduction in both length and cross-sectional area, but also in the size of their bordered pits which culminates in *Mappia* and *Nothapodytes* in the formation of libriform fibers. In the scrambling and climbing representatives of the Group IIIA Icacinoideae, as in the scandent Iodeae, Sarcostigmateae and Phytocreneae, there is a further reduction in the length of the imperforate tracheary elements and a tendency for enlargement of the bordered pits. These trends of specialization culminate — as in scandent representatives of a number of other families of the dicotyledons — in the formation of curious short tracheids which resemble the vessels in having numerous, large bordered pits.

The distribution of the wood parenchyma in the Group I Icacinoideae is dominantly of the primitive diffuse apotracheal type. However, the most highly specialized representatives of this group — i.e. from the point of view of the vessels — have parenchyma that is either transitional between diffuse and narrow-banded apotracheal, *Poraqueiba* and *Ottoschulzia*, or between diffuse and scanty abaxial paratracheal, *Emmotum*. The parenchyma of the Group II Icacinoideae fluctuates markedly in both abundance and distribution and exhibits several trends of specialization. In *Stemonurus*, *Discophora* and *Gonocaryum*, it is abundant and is transitional between diffuse (in tangentially linear aggregates) and narrow-banded apotracheal. In *Medusanthera*, it is transitional between these types of distribution and more or less irregularly banded types in which the vessels are partly or completely jacketed by parenchyma. In *Cantleya*, *Gastrolepis* and *Urandra*, the parenchyma is scanty paratracheal, but exhibits vestiges of its derivation from apotracheal. In the wood of *Leptaulus daphnoides* Benth., it is transi-

tional between diffuse and very scanty, abaxial paratracheal. Most, if not all, of the Group III Icacinoideae are characterized by having more or less paratracheal parenchyma that occurs in association with varying percentages of apotracheal. In *Merrilliodendron, Mappia* and most species of *Nothapodytes,* the apotracheal parenchyma is abundant and is either transitional between diffuse (in tangentially linear aggregates) and narrow-banded apotracheal or is dominantly banded apotracheal. On the contrary, in the scandent or semi-scandent representatives of the unilacunar Icacinoideae, as in the Iodeae and Phytocreneae, the banded apotracheal parenchyma is exceedingly unstable both as regards its abundance and its distributional patterns. In *Sarcostigma* and in certain of the Phytocreneae, there is a tendency to replace the wood parenchyma strands by curious septate, fusiform parenchymatous elements.

LITERATURE CITED

1. Bailey, I. W. The cambium and its derivative tissues II. Size variations of cambial initials in gymnosperms and angiosperms. Amer. Jour. Bot. **7**: 355–367. 1920.
2. ——— and Tupper, W. W. Size variation in tracheary cells. Proc. Amer. Acad. Arts and Sciences, **54**: 149–204. 1918.
3. ——— and Howard, R. A. The comparative morphology of the Icacinaceae II. Vessels. Jour. Arnold Arb. **22**: 171–187. 1941.
4. Chalk, L. The phylogenetic value of certain anatomical features of dicotyledonous woods. Ann. Bot. N. S. **1**: 409–428. 1937.
5. Chowdhury, K. Ahmad. Terminal and initial parenchyma cells in the wood of Terminalia tomentosa W. & A. New Phytol. **35**: 351–358. 1936.
6. Kribs, D. A. Salient lines of structural specialization in the wood parenchyma of dicotyledons. Bull. Torrey Bot. Club. **64**: 177–187. 1937.
7. Sanio, K. Vergleichende Untersuchungen über die Zusammensetzung der Holzkorpers. Bot. Zeit. **21**: 389. 1863.

DESCRIPTION OF PLATES

Plate I.

Fig. 1. *Platea species. Y. U. 20201.* Transverse section of thin-walled tracheids, showing three bordered pits in sectional view. × 1200.

Fig. 2. *Emmotum holosericeum* Ducke. *Y. U. 33816.* Transverse section of thick-walled tracheids, showing bordered pits in sectional view. × 1200.

Fig. 3. *Discophora panamensis* Standl. *Y. U. 12246.* Transverse section of fiber-tracheids and parenchyma, showing pits with reduced borders. × 1200.

FIG. 4. *Nothapodytes obtusifolia* (Merr.) Sleumer. *Y. U. 29539.* Transverse section of libriform fibers, showing simple pits. × 1200.

PLATE II.

FIG. 5. *Apodytes dimidiata* E. Mey. *Y. U. 14833.* Transverse section of the wood. Parenchyma distribution is diffuse-in-aggregates. × 50.

FIG. 6. *Poraqueiba sericea* Tul. *Y. U. 19244.* Transverse section of the wood. Parenchyma transitional between diffuse (in tangentially linear aggregates) and narrow-banded apotracheal. × 50.

FIG. 7. *Merrilliodendron rotense* Kanehira. *Y. U. 19468.* Transverse section of the wood. Parenchyma distribution is a mixture of vasicentric and diffuse-in-aggregates. × 50.

FIG. 8. *Alsodeiopsis Schumanii* Engl. *O. U. 5060.* Transverse section of the wood. Parenchyma distribution is a mixture of banded apotracheal and paratracheal. × 50.

FIG. 9. *Medusanthera samoensis* (Reinecke) Howard. *Y. U. 26117.* Transverse section of the wood. Parenchyma distribution is a mixture of irregularly banded apotracheal and paratracheal. × 50.

FIG. 10. *Urandra scorpioides* (Becc.) O. Ktze. *Y. U. 16043.* Transverse section of the wood. Parenchyma is paratracheal and vestigial apotracheal. × 50.

PLATE III.

FIG. 11. *Leptaulus daphnoides* Benth. *Y. U. 19758.* Transverse section of the wood. Parenchyma is scanty diffuse and abaxial paratracheal. × 100.

FIG. 12. *Desmostachys Vogelii* Stapf. *Y. U. 15097.* Transverse section of the wood. Parenchyma is scanty paratracheal with wing-like or aliform extensions of apotracheal. × 100.

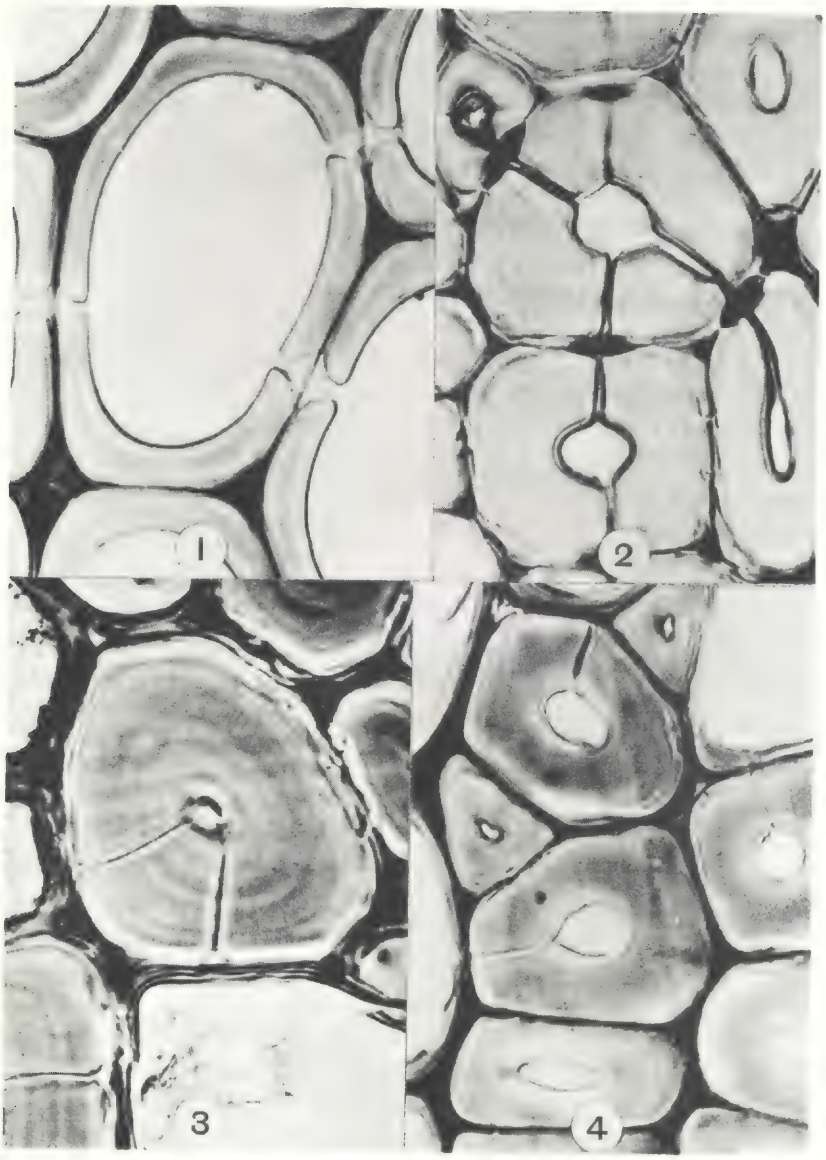
FIG. 13. *Rhaphiostylis cordifolia* Hutch. *Linder 1218.* Transverse section of a young stem. Parenchyma is scanty paratracheal and vestigial apotracheal. × 100.

FIG. 14. *Mappia racemosa* Jacq. *Y. U. 12196.* Transverse section of the wood. Parenchyma is scanty paratracheal and broad-banded apotracheal. × 100.

FIG. 15. *Pleurisanthes flava* Sand. *N. Y. 590.* Transverse section of a young stem. Parenchyma is paratracheal. × 100.

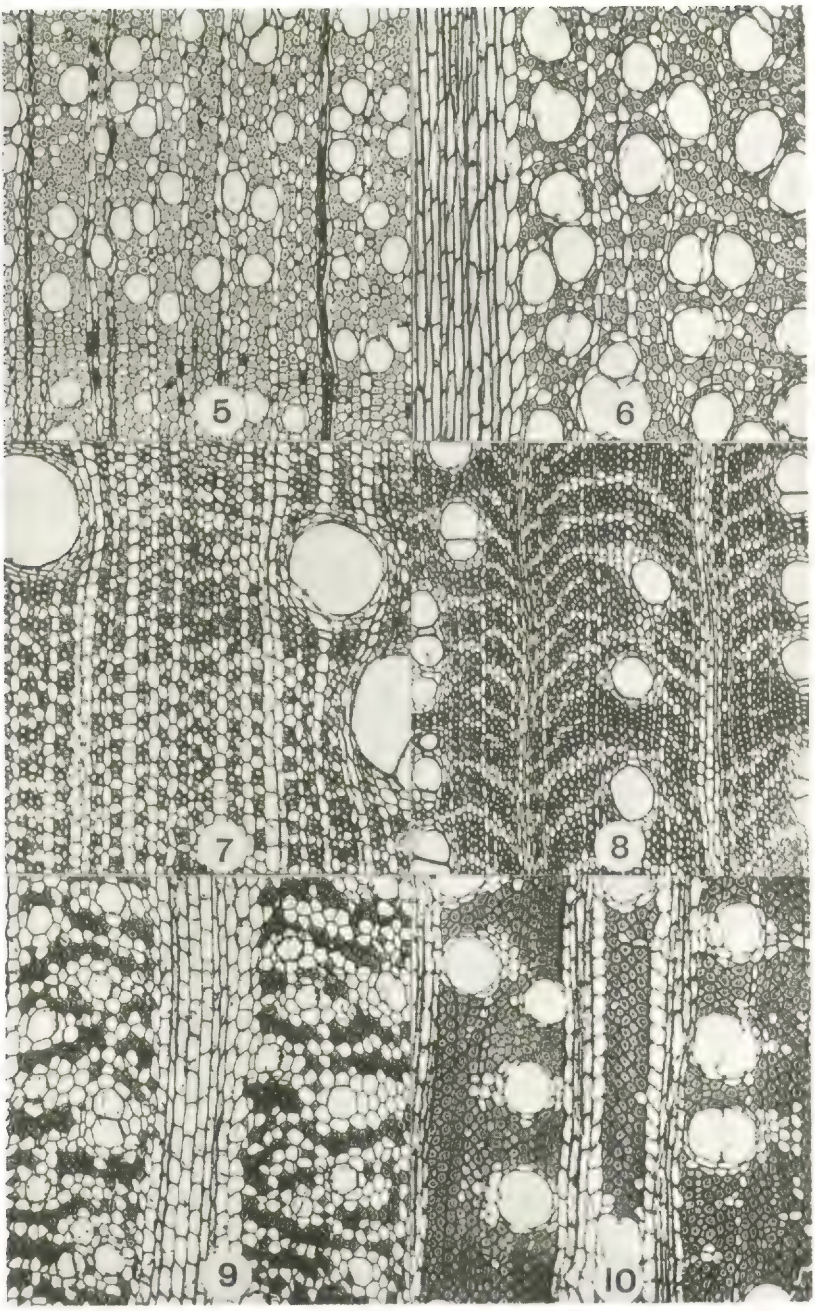
FIG. 16. *Iodes ovalis* Bl. *H. U. 2775.* Transverse section of large-vesselled anomalous secondary xylem. Parenchyma is vasicentric. × 100.

BIOLOGICAL LABORATORIES,
HARVARD UNIVERSITY.



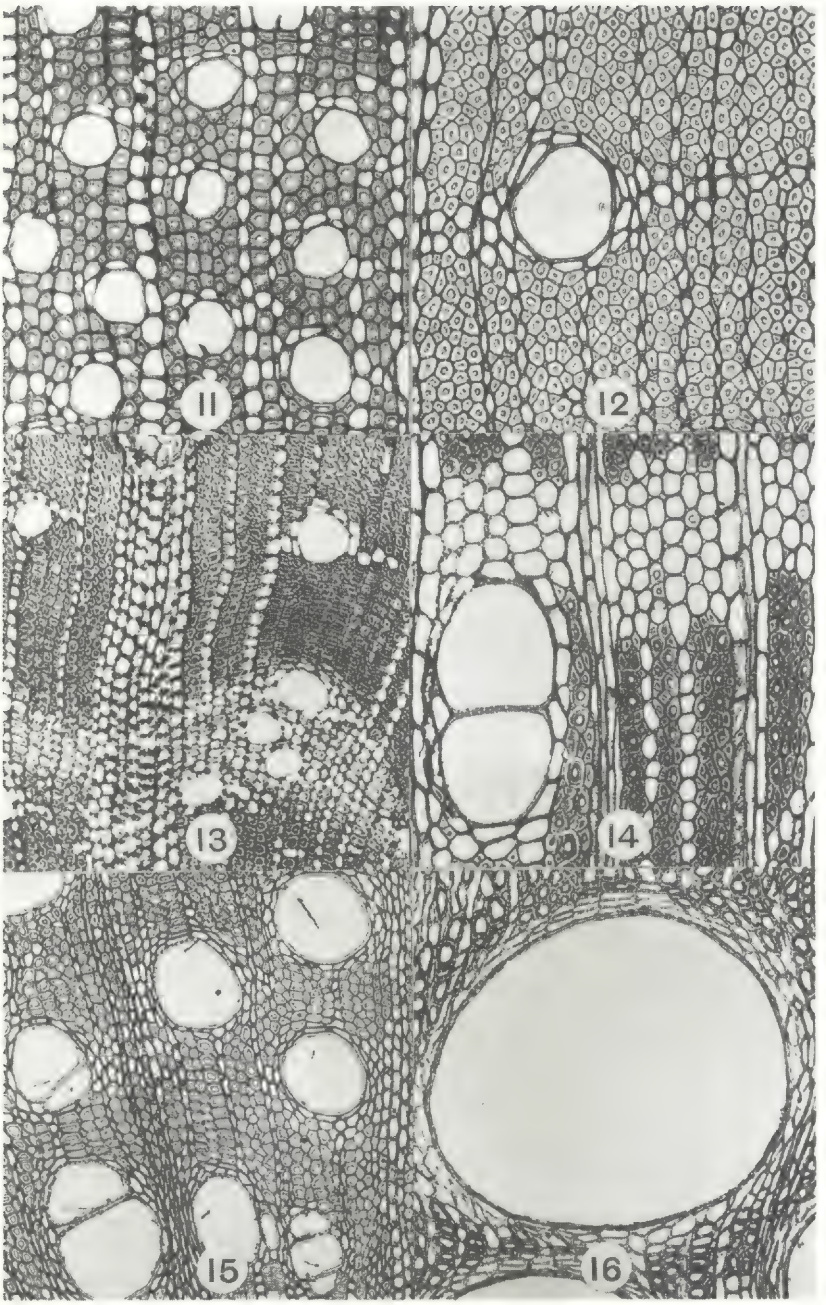
COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE—MERIDEN



COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE — MERIDEN



COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE — MERIDEN

SPECIES HYBRIDS IN FOREST TREES

E. Chalmers Smith and Charles Nichols Jr.*

In any breeding project two steps are necessary in the initial production of superior individuals. The first step is the selection of superior parental types for crossing. The choice of breeding stocks is especially important in natural populations not subjected to artificial selection. The second step is the production of hybrids between the superior types to obtain favorable gene combinations resulting in hybrid vigor. The success of such a program in tree breeding is well illustrated in the selection and breeding of *Hevea* for rubber production (Bangham and D'Angremond, 1939). In most tree breeding projects less attention can be given to the initial selection because of the time involved, and favorable results must depend more on the increased vigor of the first generation hybrids. Such a program also involves adequate methods for vegetative propagation of the F_1 hybrids.

In any comprehensive study of forest genetics the question of seed origin or provenance must play an important role. Recent papers discussing current programs for forest tree improvement emphasize this point. It may be well to recall that while forest genetics is a relatively new field of endeavor, provenance studies have been carried on since the first part of the 19th century (Langlet, 1936; Kalela, 1937). As far back as the middle of the 18th century Swedish foresters recognized the existence of distinct races or types in pine and raised the question as to whether these differences were entirely due to environmental conditions or whether some more fundamental differences were present.

Credit for the first experimental approach to the subject of seed origin should go to De Vilmorin (1862). As early as 1823 he studied seed cultures using pine seed from different regions. From these experiments De Vilmorin was able to conclude that from pine seed of different origins one would obtain trees which were quite different in form and rate of growth. Throughout the 19th century provenance studies were carried out in Europe and particularly in Sweden where experience had taught foresters that seed of German origin produced inferior stands when planted in the more rigorous climate of Sweden.

The general conclusion to be drawn from the vast number of experi-

*Cabot Fellows for research in Forest Genetics.

ments on provenance is that seed of local origin is the best type to be planted in a given region. However, as Schreiner (1937) has pointed out, there are exceptions to this general rule and for this reason more complete data on seed origin will be of invaluable aid in any program of forest genetics. It is well known that among trees of a given area there may be differences in rate of growth, form, and resistance to disease or adverse environmental conditions. For this reason it is desirable from the point of view of forest genetics to make progeny tests from individual trees in order that the very best trees may be selected for hybridizing experiments.

Simultaneously with investigations of seed origin and progeny tests actual hybridizing among forest tree genera, species, and varieties must play an important part in any program of forest tree improvement. It is only in comparatively recent years that this phase of the problem has been undertaken on a large scale. However, for over a century foresters have considered the production of entirely new types of forest trees by means of hybridization. Klotzsch (1854) was apparently the first investigator to report hybridizing experiments in forest trees. In 1845 he produced artificial hybrids in pine, oak, elm, and alder and noted remarkable vigor in the hybrids. In 1891 Luther Burbank is reported to have produced the remarkable Paradox walnut, a hybrid between *Juglans regia* and *J. californica*. It was not until the early part of the 20th century that Augustine Henry gave new impetus to the idea of breeding forest trees. In 1914 Henry reported on artificial hybridization in ash, elm, larch, poplar, beech, and oak.

Since 1914 many programs of forest tree breeding have been initiated in this country as well as in Europe. Worthy of mention among these more recent attempts are the chestnut breeding experiments endeavoring to obtain a blight resistant type, the poplar hybridization work of the Oxford Paper Company, and the work of the Institute of Forest Genetics in California which was undertaken in 1925.

In planning a program of forest tree improvement it is well to consider carefully just what improvements will be of most value. Increased vigor and rate of growth are commonly found in first generation species hybrids. This fact immediately suggests that rapidity of growth would be one of the primary aims in producing forest tree hybrids. However, there are other facts which must be taken into consideration. If a particular forest tree is used exclusively for timber production then the quality of the timber in the hybrid is of utmost importance. Generally speaking, timber from the more rapid growing conifers is somewhat weaker and inferior to the timber from slower growing trees. On the

other hand, in certain of the best hardwood timber trees, rapidity of growth tends to strengthen and improve the quality of the timber (Henry, 1914). Certain forest trees such as spruce and poplar are used largely for pulp and plastics. In such cases the strength and quality of the wood is of secondary importance. The primary aim would be the production of a rapid growing hybrid from which a merchantable crop could be obtained in a shorter period of time.

Perhaps of equal importance in hybrid forest trees is the question of disease resistance. Plant breeders dealing with agricultural crops have always found disease resistance of primary importance. In order to realize that disease resistance is important in forestry it is only necessary to recall the fate of the American chestnut. Foresters are aware of this fact and intensive breeding experiments have been in progress in an attempt to produce a chestnut which is resistant to the chestnut blight and still retains all the desirable qualities of a good timber tree.

The importance of seed origin studies and hybridization have been discussed briefly above. There is another phase of the problem which must not be neglected. Seed from first generation hybrids does not breed true. Therefore, in order to perpetuate any desirable hybrid, vegetative reproduction must be used. If vegetative reproduction can be used successfully the hybrids may be multiplied rapidly without waiting for the trees to mature and there is no danger of losing any of the first generation vigor or other advantageous characters.

Vegetative propagation of most conifers and many of the commonest hardwood trees has been considered difficult (Thimann and Delisle, 1939). Extensive studies on rooting ability reveal the fact that with the aid of optimal concentrations of auxin and proper age of the trees from which cuttings are taken, most of the difficult species can be rooted. Cuttings from young white pine trees, 3 or 4 years old, root most successfully. However, not many cuttings can be obtained from a single tree of such an age and vegetative propagation is not yet possible on a commercially profitable scale.

The recent discovery that colchicine may be used to double the chromosome number in plants makes this chemical a valuable aid to plant breeders. In cases where a species hybrid is sterile, the use of colchicine may double the chromosome number to produce a true breeding amphidiploid with complete fertility. Colchicine may be of further value in forestry by producing polyploid forms of existing forest tree types. The polyploid forms are often more vigorous than the diploid forms from which they were derived.

A study of natural hybridization is of value in showing the degree of

species hybridization in various genera. The occurrence of natural interspecific hybrids in forest trees depends upon the realization of three conditions—that flowering times of the species coincide, that the genetic relationships between the species concerned be such as to permit crossing, and that the geographic distribution of the species coincide to some extent. These conditions are sufficient to account for natural hybrids in the case of dioecious species, however, isolation mechanisms such as self-sterility, protandry, and protogyny are required in the case of monoecious species. Protandry and protogyny are widespread in forest tree genera (Larsen, 1937; East, 1940). In regard to self-sterility Larsen has this to say, "The majority of our forest trees should not be classified for purposes of breeding with the absolutely self-sterile plants but ought rather to be included among those plants which normally are cross-pollinated but can by artificial means be rendered self-pollinated."

Due to the widespread occurrence of protandry and protogyny and the occasional occurrence of dioecious species in forest trees, natural interspecific hybrids are common. Among these the London plane, *Platanus acerifolia* (Ait.) Willd., the cricket-bat willow, *Salix alba* L. var. *calva* G. F. W. Mey., and the common linden, *Tilia europaea* L., are natural hybrids of considerable economic importance. *Platanus acerifolia,* according to Henry and Flood (1919), originated in the Oxford Botanic Garden about 1670 as the result of a cross between *P. occidentalis* L. and *P. orientalis* L. This tree is extensively planted as a shade tree in localities where neither parent can survive. *Tilia europaea* is widely planted and is valuable as a hardy shade tree. It is the hybrid *T. cordata* Mill. × *T. platyphyllos* Scop. *Salix alba* var. *calva* is recognized by Henry (1914) as a hybrid between *S. alba* and *S. fragilis* L. It probably originated at Norfolk, England, about 1700 and is used extensively in the manufacture of cricket-bats. However, Wilkinson (1941), on the basis of a cytological investigation of *S. alba, S. fragilis,* their varieties and hybrids concludes that *S. alba* var. *coerulea* (= *S. alba* var. *calva*) is a variety of *S. alba* and not a hybrid.

The occurrence of natural hybrids in the genera of forest trees and the success of artificial species hybrids provides some information of value in planning a breeding program, and at the same time indicates the relationships of the species in the various genera. The chromosome numbers also are of interest in respect to crossing diploid and polyploid species, and provide some indication of the probable success of the artificial production of polyploids.

The data on natural and artificial interspecific hybrids in sixteen genera of local importance are shown in table 1. Of these genera only

one, *Fagus* L., has no interspecific hybrids reported. The table is based for the most part on the list of interspecific hybrids in tree genera published by Johnson (1939). Some additions and changes have been made. Crosses using varieties of species or hybrids which have not been assigned a specific name as parents have been omitted. It is unfortunate that in the original hybrid lists, the name of the authority for the species name was often omitted. Nevertheless, an attempt has been made to bring these lists into agreement with the system of naming used by Rehder (1940). The same authority was used for approximate number of species within the genera and for division of the genera into subgenera, sections and series. Chromosome numbers were taken from the lists of Tischler (1927, 1931, 1936, 1938) and from various later publications (Peto, 1938; Dillewijn, 1940; Duffield, 1940). In the case of *Populus* and *Catalpa* some chromosome numbers were taken from the work of Smith (unpublished).

TABLE I

Genus	Species in Genus	Chromosome Number	Natural Hybrids	Artificial Hybrids	Species used in crosses
Abies	40	12	2	1	5
Acer	115	13, 26, 39, 52 2	10	1	11
Betula	40	14, 28, 35, 42	11	11	14
Carya	20	16, 32	7	0	7
Castanea	10	12	6	10	8
Catalpa	10	20	1	1	2
Fagus	10	12	0	0	0
Fraxinus	65	23, 69	0	4	4
Juglans	15	16	7	8	6
Larix	10	12	6	4	9
Picea	40	12	4	3	6
Pinus	80	12	11	7	20
Populus	30	19, 57 2	12	81	27
Quercus	200	12	60	2	50
Tilia	30	41, 82	9	0	9
Ulmus	18	14, 28	3	3	7

The genus *Acer* L. is divided into fourteen sections. The hybrids listed are the result of crosses between species within the section *Platanoidea* Pax and the section *Spicata* Pax, and crosses between species belonging to different sections as follows: *Platanoidea* × *Campestria* Pax, *Campestria* × *Spicata*, *Spicata* × *Macrantha* Pax. Most of the crosses occur between the sections *Campestria* and *Spicata* with only one cross between the sections *Spicata* and *Macrantha*. Chromosome counts up to this time, based on the examination of some seventeen species, show a polyploid series based on a reduced number of n = 13. Meurman (1933) finds that, on the basis of secondary association of chromosomes in *A. platanoides* L., the basic ancestral chromosome number is n = 12. The genus is self-fertile as far as is known (East, 1940). The artificial cross *A. rubrum* L. × *A. saccharinum* L. has been reported by Freeman (1941). Both parent species belong to the section *Rubra* Pax.

The genus *Fraxinus* L. is divided into sections and subsections. Johnson (1939) does not list any hybrids in this genus, but Henry (1914) reports seedlings from four crosses. Some of these were seen by Anderson in 1934 (Anderson and Whelden, 1936), at which time they were vigorous young trees. All four crosses occur between species within the same section of the genus, *Fraxinaster* DC. Two are crosses within the subsection *Melioides* Endl., and two are crosses between the subsections *Melioides* and *Bumelioides* Engl. The work of Anderson and Turrill (1938) indicates that natural hybridization does take place in the case of *F. oxycarpa* Willd. and *F. Pallisae* Wilmott. Of the six species for which chromosome numbers have been determined, five have the reduced number n = 23 while one species has n = 69. East (1940) reports no cases of self-sterility in this genus.

Quercus L. is divided into three subgenera, the last of which is redivided into six sections. Hybridization in this genus seems to be limited to species which belong to the same subgenus (Trelease, 1924; Johnson, 1939). In the case of the subgenus *Lepidobalanus* Endl., crossing occurs between species belonging to different sections, although most of this is limited to the section *Prinus* Loud. On the basis of chromosome counts of forty-six species, the genus has a chromosome number of n = 12.

The Fagales and especially the genera *Betula* L., *Fagus* L., *Castanea* Mill., and *Quercus* are very protandrous, so much so that isolated trees bear almost no fruit, but there seems to be no difficulty in getting selfed seed by artificial pollination. All are self-fertile (East, 1940). The chromosome number in *Fagus* is 12, in *Castanea* 12, in *Betula* the base

number is 14 but a polyploid series of 14, 28, 35, and 42 exists. These reduced numbers are founded on chromosome counts of one, two, and twenty-five species and varieties respectively.

The genus *Populus* L. is divided into five sections, *Leuce* Duby, *Leucoides* Spach, *Tacamahaca* Spach, *Aegeiros* Duby, and *Turanga* Bge. Species hybrids within and between the sections *Leuce, Tacamahaca* and *Aegeiros* are known, although those within and between the latter two sections are the most common. Johnson (1939) states that there appears to be little limitation to species hybridization in this genus. Heimburger (1940) sees a definite limitation to species hybridization based on genetic affinities which cause crossing to follow a series similar to the series aspens — silver poplars — cottonwoods — balsam poplars. Thus far no crosses involving species belonging to the sections *Leucoides* and *Turanga* have been reported, but it seems to be possible to make any desired cross between and within the remaining three sections. Chromosome counts based on the investigation of thirty-six species and varieties of *Populus* show the reduced number in this genus to be 19. Occasional triploid forms are known within the section *Leuce*. One tetraploid form has been reported, but subsequent investigations show that $n = 19$ is the common haploid number for this species, although it is conceivable that it does exist in the tetraploid form. Dillewijn (1940), on the basis of secondary association of chromosomes at pre-meiotic metaphase of the meiotic divisions, concludes that $n = 8$ is the real base number and that the genus is a secondary polyploid. The genus is dioecious as a rule. When monoecious trees appear they are self-fertile (East, 1940).

Ulmus L. is divided into five sections. The reported hybrids occur between species in the section *Madocarpus* Dum. There is one exception, the probable hybrid which Klotzsch produced in 1845 and reported as *U. campestre* × *U. effusa*. The parent species, if correctly given, here belong to the sections *Madocarpus* and *Blepharocarpus* Dum. respectively. Chromosome counts of thirteen species show the reduced number to be 14, with one tetraploid species. As far as is known all species within this genus are self-fertile but there is marked protogyny (East, 1940).

The genus *Carya* Nutt. has a haploid number of $n = 16$, with some tetraploid species. These conclusions are based on an investigation of seven species. *Juglans* L. also has a reduced number of 16 based on counts of seven species. East (1940) has investigated all the common species of *Juglans* and *Carya* and finds them to be self-fertile, though tending to be protandrous.

Tilia L. has one or more species known to be self-fertile, while a considerable amount of protandry is known in the Tiliaceae. In *Tilia*, chromosome counts on 12 species show the basic haploid number to be $n = 41$, with both diploids and tetraploids known in the genus. *Catalpa* Scop., of the Bignoniaceae, is a self-fertile genus (East, 1940). The haploid chromosome number in the genus is 20 based on the examination of three species.

The genus *Picea* A. Dietr. is divided into three sections. The hybrids listed occur as the result of crosses both between and within sections, with more occurring between than within the sections.

Pinus L. is divided into two subgenera, three sections, and ten series. With few exceptions hybrids occur between species belonging to the same series. There are no reported hybrids from crosses of species belonging to different sections or subgenera. The parents of most of the reported hybrids belong to the subgenus *Diploxylon* Koehne, section *Pinaster* Endl. Two hybrids are reported between species belonging to the subgenus *Haploxylon* Koehne, section *Cembra* Spach.

In the genera of the Pinaceae considered here all the species thus far investigated have the reduced chromosome number of $n = 12$. This number is based on the examination of five, six, five, and twenty-one species respectively for the genera *Abies* Mill., *Larix* Mill., *Picea*, and *Pinus*. They are thought to be self-fertile though normally cross-pollinated (Larsen, 1937).

The hybridization work at the Arnold Arboretum has been limited largely to *Populus*, *Betula* and *Pinus*. These genera are of value in reforestation projects particularly where the trees are to be used as a source of cellulose. The incidence of both natural and artificial hybrids shows that interspecific hybridization in these genera occurs readily.

The technique employed in the hybridization of forest trees is essentially that employed in the breeding of any flowering plants. Schreiner (1938), among others, has published on methods of tree hybridization. However, each genus requires modifications of the general technique.

Yanchevsky (1904) seems to have been the first to use a method by which flowering branches of *Salix* were brought into the greenhouse, flowered, and seed matured. Wettstein (1933) employed this method in *Populus*. The authors have also used this method in this genus, where it has proved most successful in the case of species belonging to the section *Leuce*. Crosses in other sections of the genus were more successful when made on the trees. Since pollen from all species of *Populus* may be forced in the greenhouse, the advantage of being able to overcome natural differences in blooming time is not lost when crossing must be done in the field.

The forcing of pollen in the greenhouse may be used successfully in the case of *Betula*. Here sausage tubing may be used in place of the usual glassine bags when it is desired to cover a large number of small flowers on one branch. The best results were obtained when the ends of the tube were plugged with cotton wool, thus allowing for some aëration.

Ulmus may be treated in a manner similar to *Populus* in that branches may be brought into the greenhouse and flowered, crosses made, and seed matured. The perfect flowers of *Ulmus* are small and difficult to emasculate. However, since the genus is strongly protogynous, crosses may be made without emasculation. This method was used successfully by the authors in certain crosses made in the greenhouses of the Arnold Arboretum in the spring of 1938. As the knowledge of flowering habits in forest trees grows, increasing use of protandry, protogyny, and self-sterility will simplify hybridization techniques.

Isolated trees of dioecious species or of monoecious species which are strongly protandrous or protogynous may be used as a source of hybrid seed providing that trees of other species in the genus are flowering in the neighborhood. Accurate records on the blooming times of all trees in the vicinity will aid in determining what the male parents probably are.

In the genus *Quercus* there are a large number of natural hybrids but very few reports of artificial hybrids. This must indicate that proper techniques have not yet been developed for this group. A similar lack of technique probably accounts for the failure to obtain artificial hybrids in the genus *Acer*.

There is some evidence that an overabundance of pollen on the stigmas of female flowers in *Juglans* and *Carya* prevents crosses from being successful. Special techniques are needed in order that small amounts of pollen can be used when dealing with these groups.

Very often a cross may yield a good set of seed but the seed may not germinate. In many cases this failure of germination may be due to an upset in the ratio of embryo size to endosperm size. This difficulty may be overcome by making use of the technique of embryo culture. If the embryo is removed from the seed at the critical stage and placed on nutrient media a healthy and mature plant may be obtained where ordinary methods of germination fail.

Crosses between species of *Pinus* and other genera of conifers have been made, but the resulting seedlings are not large enough for critical study. The work on *Pinus* has been confined to the white pine species.

The hybrids in the genus *Populus* are grown in nursery plots and are cut back severely to induce an abundance of lateral sprouts from which

cuttings can be obtained. These cuttings will provide the trees to be tested at the Harvard Forest in comparison with the parental species or with hybrids of known value.

The authors have attempted a number of interspecific crosses in the genera *Abies, Betula, Carya, Catalpa, Fagus, Fraxinus, Juglans, Picea, Pinus, Populus, Quercus,* and *Ulmus* during the past three years. This work has been done under the Maria Moors Cabot Foundation for Botanical Research on trees growing in the Arnold Arboretum of Harvard University. The following list of crosses represents part of the work done in the years 1938 and 1939. The resulting trees have been tentatively identified as hybrids. No attempt has as yet been made to compare the vigor of these young trees with that of the parent trees or with other hybrids, but the cross *Ulmus Wilsoniana* Schneid. × *U. japonica* (Rehd.) Sarg. seems to be more vigorous and more resistant to insect attack than is *U. japonica.* Among the hybrids in the genus *Populus,* those crosses using the species *P. Maximowiczii* Henry as the female parent seem to be the most promising.

Betula L.

B. mandshurica (Reg.) Nakai var. *japonica* (Miq.) Rehd. × *B. lenta* L.
B. mandshurica (Reg.) Nakai var. *japonica* (Miq.) Rehd. × *B. Maximowicziana* Reg.
B. mandshurica (Reg.) Nakai var. *japonica* (Miq.) Rehd. × *B. nigra* L.
B. mandshurica (Reg.) Nakai var. *japonica* (Miq.) Rehd. × *B. populifolia* Marsh.
B. mandshurica (Reg.) Nakai var. *japonica* (Miq.) Rehd. × *B. papyrifera* Marsh.
B. lutea Michx. × *B. lenta* L.
B. papyrifera Marsh. var. *kenaica* (Evans) Henry × *B. mandshurica* (Reg.) Nakai var. *japonica* (Miq.) Rehd.
B. populifolia Marsh. × *B. lenta* L.
B. populifolia Marsh. × *B. papyrifera* Marsh.

Populus L.

P. alba L. var. *nivea* Ait. × *P. deltoides* Marsh.
P. alba L. var. *nivea* Ait. × *P. adenopoda* Maxim.
P. canescens (Ait.) Sm. × *P. alba* L. diploid
P. canescens (Ait.) Sm. × *P. alba* L. triploid
P. canescens (Ait.) Sm. × *P. deltoides* Marsh.
P. canescens (Ait.) Sm. × *P. tomentosa* Carr.
P. cathayana Rehd. × *P. deltoides* Marsh.
P. cathayana Rehd. × *P. laurifolia* Ledeb.
P. deltoides Marsh. × *P. acuminata* Rydb.
P. deltoides Marsh. × ×*P. canadensis* Moench.
P. deltoides Marsh. × *P. nigra* L.
P. Maximowiczii Henry × *P. deltoides* Marsh.

P. Maximowiczii Henry × *P. laurifolia* Ledeb.
P. Maximowiczii Henry × *P. nigra* L.
P. Maximowiczii Henry × *P. tomentosa* Carr.
P. nigra L. var. *italica* Muenchh. × ×*P. canadensis* Moench.
P. Sargentii Dode × *P. acuminata* Rydb.
P. Sargentii Dode × *P. deltoides* Marsh.
P. Tacamahaca Mill. × ×*P. canadensis* Moench.
P. Tacamahaca Mill. × *P. deltoides* Marsh.
P. Tacamahaca Mill. × *P. nigra* L.
P. Tacamahaca Mill. × *P. nigra* L. var. *italica* Muenchh.
P. Tacamahaca Mill. × *P. Simonii* Carr.
P. tomentosa Carr. × *P. adenopoda* Maxim.
P. tomentosa Carr. × *P. alba* L. diploid
P. tomentosa Carr. × *P. alba* L. triploid

Ulmus L.

×*U. hollandica* Mill. × *U. japonica* (Rehd.) Sarg.
U. Wilsoniana Schneid. × *U. japonica* (Rehd.) Sarg.

LITERATURE CITED

Anderson, E. and C. M. Whelden, Jr. (1936) Studies in the genus Fraxinus II. Jour. Hered. **27**: 473–474.

——— and W. B. Turrill (1938) Statistical studies on two populations of Fraxinus. New Phytologist **37**: 160–172.

Bangham, W. N. and A. D'Angremond (1939) Tapping results on some new A. V. R. O. S. Hevea clones which originated in cross-pollinations. Archief voor de Rubbercultuur **23**: 191–231.

Dillewijn, C. van (1940) Zytologische Studien in der Gattung Populus L. Genetica **22**: 131–182.

Duffield, J. W. (1940) Chromosome counts in Quercus. Amer. Jour. Bot. **27**: 787–789.

East, E. M. (1940) The distribution of self-sterility in the flowering plants. Proc. Amer. Phil. Soc. **82**: 449–518.

Elwes, J. H. and A. Henry (1913) Trees of Great Britain and Ireland. Vol. 7. Edinburgh.

Freeman, O. M. (1941) A red maple, silver maple hybrid. Jour. Hered. **32**: 11–14.

Heimburger, C. (1940) Report on popular hybridization II. Forestry Chronicle **16**: 149–160.

Henry, A. (1914) The artificial production of vigorous trees. Jour. Dept. Agric. and Tech. Inst. Ireland **15**: 2–20.

——— and M. G. Flood (1919) The history of the London plane. Proc. Roy. Irish Acad. **35**: 9–28.

Johnson, L. P. V. (1939) A descriptive list of natural and artificial interspecific hybrids in North American forest-tree genera. Canad. Jour. Res. **17**: 411–444.

Kalela, A. (1937) Zur Synthese der experimentellen Untersuchungen über Klimarassen der Holzarten. Com. Inst. Forest. Fenniae **26**: 1–434.

KLOTZSCH, J. F. (1854) Ueber die Nutzanwendung der Pflanzen-Bastarde und Mischlinge. Ber. Verhandl. K. Preuss. Akad. Wiss. Berlin **1854**: 535–562.

LANGLET, O. (1936) Studier över tallens Fysiologiska Variabilitet och dess Samband med Klimatet. Medd. fr. Stat. Skogsforsoksanst. **29**: 421–470. (Translation No. 293 U. S. Forest Service, Div. of Silvics.)

LARSEN, C. SYRACH (1937) The employment of species, types, and individuals in forestry. Roy. Vet. and Agric. Col. Copenhagen Yearbook 1937.

MEURMAN, O. (1933) Chromosome morphology, somatic doubling and secondary association in Acer platanoides L. Hereditas **18**: 145–173.

PETO, F. H. (1938) Cytology of Poplar species and natural hybrids. Canad. Jour. Res. **16**: 445–455.

REHDER, A. (1940) Manual of cultivated trees and shrubs. 2nd Ed. MacMillan Co., New York.

SCHREINER, E. J. (1937) Improvement of forest trees. U. S. Dept. Agric. Yearbook **1937**: 1241–1279.

———. (1938) Forest tree breeding technique. Jour. Forestry **36**: 712–715.

THIMANN, K. V. AND A. L. DELISLE (1939) The vegetative propagation of difficult plants. Jour. Arnold Arb. **20**: 116–136.

TISCHLER, G. (1927) Pflanzliche Chromosomes-Zahlen. Tabulae Biologicae **4**: 1–83.

———. (1931) Pflanzliche Chromosomes-Zahlen. Tabulae Biologicae **7**: 109–226.

———. (1936) Pflanzliche Chromosomen-Zahlen. Tabulae Biologicae **12**: 57–115.

———. (1938) Pflanzliche Chromosomen-Zahlen. Tabulae Biologicae **16**: 162–218.

TRELEASE, W. (1924) The American Oaks. Mem. Nat. Acad. Sci. **20**: 1–255. t. 1–420.

DE VILMORIN (1862) Exposé historique et déscriptif de l' Ecole forestière des Barres près de Nogent-sur-Vernisson (Loiret). Mem. Soc. Imper. Centr. d'Agric. France S. 1–61. Paris.

WETTSTEIN-WESTERSHEIM, V. VON (1933) Die Kreuzungsmethode und die Beschreibung von F_1 Bastarden bei Populus. Zeitschr. Züchtung. A. Pflanzenzüchtung **18**: 597–626.

WILKINSON, J. (1941) The cytology of the Cricket Bat Willow. Ann. Bot. **5**: 149–167.

YANCHEVSKY, K. (1904) On the peculiarities of the germination of the seeds of Aspen and of some species of Willow. (Russian) Proc. Imperial Forest. Inst. **11**: 269–274.

BIOLOGICAL LABORATORIES,
HARVARD UNIVERSITY.

A NOTE ON THE DATES OF ISSUE OF THE FASCICLES COMPRISING COSSON'S "ILLUSTRATIONES FLORAE ATLANTICAE" 1882–1897

E. D. Merrill

As noted by Stearn* in his comprehensive consideration of the dates of publication of this important two-volume work, the inclusive dates for volume one are 1882–1890 and for volume two 1893–1897, publication thus extending over a period of fifteen years. The only reason for the publication of this note is the fact that Stearns saw no fascicle covers, which carry the dates of publication and the inclusive pages and plates of each fascicle. A second set of the work was recently acquired by the Arnold Arboretum, this fortunately in its original fascicle covers. In our bound library set the fascicle covers are missing, and this seems to be the case in most libraries; the chief reason for their non-preservation, other than the earlier and unfortunately common practice of discarding such covers, is probably due to the fact that the covers are of rather heavy bristol board and thus were not adaptable to binding. The following data are taken directly from the original fascicle covers:

	Fascicle cover dates	Stearns' dates
VOLUME I		
Fasc. I, pp. 1–36, *t. 1–25.*	Sept., 1882	Oct. 10, 1882
Fasc. II, pp. 37–72, *t. 26–50.*	Aug., 1884	August, 1884
Fasc. III, pp. 73–120, *t. 51–73.*	Dec., 1888	Jan.–Feb., 1889
Fasc. IV, pp. 121–159, *t. 74–98.*	Oct., 1890	Jan. 10, 1891
VOLUME II		
Fasc. V, pp. 7–42, *t. 99–123.*	Feb., 1892	April, 1892
Fasc. VI, pp. 43–82, *t. 124–148.*	Nov., 1893	Nov.–Dec., 1893
Fasc. VII, pp. 1–6, 83–125, *t. 149–175.*	May, 1897	July–Aug., 1897

*Stearn, W. T. Dates of publication of some floras of north-west Africa: Desfontaines' "Flora Atlantica," Cosson's "Compendium," Cosson and Baratte's "Illustrationes," Battander and Trabut's "Flore." Jour. Soc. Bibl. Nat. Hist. 1: 145–150. 1938.

While it is a well known fact that the printed dates on fascicle covers are not always the *exact* dates of issue, they are in general dependable. Here is a case where there is a rather remarkable agreement as to the dates of issue of the several parts as between the data taken directly from a set of the original fascicle covers and those derived from Stearn's critical search of records and reviews. For fascicle two the dates are the same by both methods, August, 1884; fascicles one, three and six are about one month earlier than the dates as derived by Stearn; fascicle five is at most two months earlier; and fascicles four and seven are between two and three months earlier.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

JOURNAL

OF THE

ARNOLD ARBORETUM

VOL. XXII OCTOBER, 1941 NUMBER 4

STUDIES IN THE THEACEAE, VIII
A SYNOPSIS OF THE GENUS FREZIERA

CLARENCE E. KOBUSKI

THERE has been considerable controversy over the name of this genus. By a vote of the committee of the International Rules of Botanical Nomenclature (1935), it was decided to conserve the name *Freziera*, in preference to *Eroteum* or *Lettsomia*.

The genus *Eroteum* was founded by Swartz (Prod. Veg. Ind. Occ. 85) in 1788 and two species, *E. theaeoides* and *E. undulata* were described. Three years later, Swartz elaborated upon this earlier description (still under the name of *Eroteum*) in Schreber, Gen. Pl. (ed. 8) **2**: 807. 1791. However, in his Fl. Ind. Occ. **2**: 971. 1800, Swartz changed the name *Eroteum* to *Freziera* in honor of a botanist who travelled in South America. He maintained the same two species under the names, *F. "theoides"* and *F. undulata*.

Choisy (Mém. Soc. Phys. His. Nat. Genève, **14**: 109–110. 1855) observed that two distinct generic elements were being included under the genus *Freziera* and that, of the two original species described by Swartz, the first, *F. theaeoides* (generally considered the type) belonged to Thunberg's Asiatic genus, *Cleyera;* the second species, *F. undulata*, represented the true *Freziera*. All the other species in this complex, described by various authors up until this time, were generically placed by Choisy. Since the publication of the work of Choisy, most botanists have accepted the name *Freziera*, and up until 1893, the majority of species were described under this name.

In 1893, Szyszylowicz, in his treatment of the Theaceae for Engler & Prantl's Nat. Pflanzenfam. combined *Ternstroemiopsis, Cleyera* and *Freziera* under the genus *Eurya* and designated them as sections. Urban protested vigorously (1896) and insisted that the four distinct entities

should be maintained as separate genera and as such has always treated his West Indian material. Still, in 1925, Melchior in the second edition of Engler & Prantl's Nat. Pflanzenfam. listed Szyszylowicz's sections as subgenera. As a result of the works of Szyszylowicz and later, of Melchior, the name *Eurya,* although belonging strictly to an Asiatic and Australasiatic genus, has been used by many botanists instead of *Eroteum, Lettsomia,* or *Freziera.*

Finally, thanks to a slight controversy between Sprague on one side and Fawcett and Rendle on the other side, the generic status, *Freziera* vs. *Eroteum,* was brought to the attention of the International Congress and by a vote of the committee the name *Freziera* was conserved relegating *Eroteum* and *Lettsomia* to synonymy.

In examining the relationship between *Freziera* and *Eurya* one cannot help being impressed, at first, by the similarity in the fruiting characters. The fruit are quite alike in appearance; both may have cell variation ranging from 3–4–5. However, the number of seeds differs in the two genera. In *Eurya* there are usually only 4–10 seeds in each locule while in *Freziera* the number per locule varies from 10–60. The flowers in *Eurya* are considerably smaller than those found in *Freziera* and offer slight characters for specific delimitation. In *Eurya,* the style is 3–4- or 5-parted according to the number of cells in the ovary. This partition of the style may vary from a slight separation at the apex to a complete separation to the base. The ovary is usually globose and contracts sharply at its juncture with the style. In *Freziera* the style is never parted and there is little constriction at the point of union with the ovary. The ovary is quite conic in shape and tapers evenly through an unparted style to the stigma. The petals in *Eurya* are imbricate, alternating with the sepals and are united for at least one-third their entire length. In *Freziera* the petals are usually free to the base, seldom united and if so, merely at the very base. In *Eurya,* the flowers are always dioecious; staminodia are seldom found in the pistillate flower and seldom are there signs of a vestigial ovary in the staminate flower. In *Freziera,* the flowers are dioecious or, as Urban puts it, gynodioecious. In the pistillate flower is found always a full series of staminodia. In the staminate flowers occurs a seemingly well developed ovary with distinct loculi and from gross appearance well developed ovules. Only a functioning stigma seems to be lacking. Urban maintains that this latter type of flower drops early from the branch, hence one does not know whether the ovary actually might function. It is these flowers which most students have in mind when they attribute hermaphroditic flowers to the genus. Urban infers that some species of *Freziera* may be hermaphro-

ditic. However, I have never found a single flower which I could definitely state as being such.

The persistent bracteoles at the base of the calyx-lobes in *Freziera* are extremely variable in the genus and play an important rôle in specific delimitation. In *Eurya,* these bracteoles are insignificant as characters. The leaves of all species in *Freziera* have "winged" petioles caused by a narrow continuation of the leaf-blade to the base of the petiole. This character is entirely lacking in all species of *Eurya.*

In addition to the material deposited in the herbarium of the Arnold Arboretum (AA), specimens from the Gray Herbarium (G), the Field Museum of Natural History (FM), the Missouri Botanical Garden (MO), the New York Botanical Garden (NY), and the United States National Museum (US) were used in this study.

Freziera Swartz, Fl. Ind. Occ. **2**: 971. 1800, in part; in Willdenow, Sp. Pl. **2**[2]: 1179. 1800, in part. — Humboldt & Bonpland, Pl. Aequin. **1**: 22. 1808. — De Candolle, Prodr. **1**: 524. 1824, in part. — Endlicher, Gen. Pl. no. 5412. 1840. — Tulasne in Ann. Sci. Nat. sér. 3, **8**: 326. 1847, in part. — Choisy in Mém. Soc. Phys. Hist. Nat. Genève, **14**: 120 (Mém. Ternstroem. 32). 1855, emend. — Bentham & Hooker, Gen. Pl. **1**: 183. 1862. — Triana & Planchon in Ann. Sci. Nat. sér. 4, **18**: 261. 1862. — Wawra in Martius, Fl. Bras. **12**[1]: 282. 1886. — Urban in Berichte Deutsch. Bot. Gesellsch. **14**: 50. 1896; in Bot. Jahrb. **21**: 541. 1896. — Fawcett & Rendle in Jour. Bot. **60**: 362. 1922. — Sprague in Jour. Bot. **61**: 85. 1923. — Internat. Rules Bot. Nomencl. ed. 3, 135. 1935.

Eroteum Swartz, Prodr. 85. 1788, in part; in Schreber, Gen. Pl. ed. 8, **2**: 807. 1791, in part. — Baillon, Hist. Pl. **4**: 256. 1873.

Lettsomia Ruiz & Pavon, Prodr. 77, t. 14. 1794. — De Candolle, Prodr. **1**: 525. 1824. — Endlicher, Gen. Pl. no. 5413. 1840. — Choisy in Mém. Soc. Phys. Hist. Nat. Genève, **14**: 123 (Mém. Ternstroem. 35). 1855.

Eurya § *Freziera* Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Hieronymus in Bot. Jahrb. **20**, Beibl. **49**: 49. 1895.

Eurya subgenus *Freziera* Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148. 1925.

Trees or rarely shrubs. Leaves coriaceous or occasionally membranaceous, usually lightly serrulate, occasionally subentire. Flowers dioecious or "gynodioecious," in fascicles in the leaf-axils or on abbreviated flowering branchlets. Bracteoles 2, opposite, at apex of peduncle, just beneath sepals. Sepals 5, imbricate, persistent, concave, the outer sepals varying from the inner sepals in size and texture. Petals 5, imbricate, alternating with sepals, unequal, usually free to the

base. Staminate flowers: stamens 15–30 uniseriate; filaments adnate to the base of the petals; anthers linear or ovate-elliptic, glabrous, usually dehiscing to the base. Ovary free, glabrous, 3- or 5-celled, rarely 4-celled, attenuated into an entire style; ovules many; stigma non-functioning. Pistillate flower: staminodia less in number than the stamens, adnate to base of the petals or attached to the disk. Ovary and style as in ♂ fl., stigma the same number of lobes as cells in the ovary. Fruit indehiscent, conic-globose; seeds 10–50 in each cell, small, 0.5–1.0 mm. diameter.

TYPE SPECIES: **Freziera undulata** Swartz.

KEY TO THE SPECIES

1. Leaves deeply cordate at base ..... 1. *F. cordata*
1. Leaves rounded, obtuse or cuneate at base, not cordate 2

2. Leaf-base decidedly unequal 3
2. Leaf-base equal or if unequal, hardly perceptible 11

3. Leaf-margin undulate 4
3. Leaf-margin serrulate or subentire, not undulate 5

4. Branchlets, petioles, peduncles and bracteoles covered with a persistent dense yellow-brown villous pubescence .... 2. *F. hirsuta*
4. Pubescent only on very young growth, quickly becoming glabrous ..... 3. *F. undulata*

5. Leaves not over 2 cm. long and 1 cm. wide ..... 4. *F. suberosa*
5. Leaves over 10 cm. long and 4 cm. wide 6

6. Branchlets glabrous or very lightly pubescent; calyx lobes glabrous 7
6. Branchlets covered with a tawny or ferrugineous pubescence; calyx-lobes (outer lobes, at least) pubescent 8

7. Ovary and fruit 3-celled; stigma 3-parted; leaves sessile or if petioled, very slightly so ..... 5. *F. angulosa*
7. Ovary and fruit 5-celled; stigma 5-parted; petioles 1.5–3.5 cm. long ..... 6. *F. Hieronymi*

8. Flowers and fruit borne in fascicles on abbreviated flowering stems of more than a single year's duration .. 7. *F. guatemalensis*
8. Flowers and fruit in simple fascicles lacking a common "peduncle" 9

9. Pedicels short, 2–4 mm. long; ovary and fruit 5-celled; stigma 5-parted ..... 8. *F. macrophylla*
9. Pedicels up to 7 mm. long; ovary and fruit 3-celled; stigma 3-parted 10

10. Petioles 3–4 cm. long; lateral veins 25–30 pairs; bracteoles suborbicular ..... 9. *F. Smithiana*
10. Petioles ca. 1 cm. long; lateral veins up to 20 pairs; bracteoles apiculate ..... 10. *F. inaequilatera*

11. Petioles longest in the genus, 5 cm. long .... 11. *F. Friedrichsthaliana*

11. Petioles not over 3.5 cm. long 12
12. Leaves spathulate, generally rounded at apex .... 12. *F. spathulifolia*
12. Leaves not spathulate 13
13. Leaf-base rounded, truncate or obtuse, not cuneate 14
13. Leaf-base distinctly cuneate and tapering 24
14. Calyx-lobes (not to be confused with bracteoles which may be pubescent) glabrous 15
14. Calyx-lobes and bracteoles densely hirsute, tomentose or sericeous 20
15. Leaves densely tomentose on under surface, very thick 13. *F. longipes*
15. Leaves glabrous, glabrescent or lightly pubescent on under surface, not tomentose; chartaceous to subcoriaceous, not thick 16
16. Petioles 0.5–1.5 cm. long 17
16. Petioles long, 2.5–3.5 cm. 18
17. Leaves 20–26 cm. long, 8–9 cm. wide; petioles up to 0.5 cm. long ..... 14. *F. calophylla*
17. Leaves 15 cm. or less long, 5–6 cm. wide; petioles 1.0–1.5 cm. long ..... 15. *F. nervosa*
18. Leaves ca. 6 cm. wide; margin serrulate ..... 16. *F. verrucosa*
18. Leaves extremely wide, up to 10 cm.; margin subentire 19
19. Pedicels 2–3 mm. long; leaves submembranaceous, less than 20 cm. long, obtuse or abrupt and short-acuminate at the apex, 20 or less pairs of veins ..... 17. *F. subintegrifolia*
19. Pedicels 7–10 mm. long; leaves heavy coriaceous, 22–29 cm. long, long-acuminate, 30–35 pairs of veins ..... 18. *F. caloncura*
20. Ovary and fruit 3-celled; stigma 3-parted 21
20. Ovary and fruit 5-celled; stigma 5-parted 23
21. Flowers and fruit borne in fascicles on abbreviated flowering stems of more than one year's duration ..... 19. *F. lancifolia*
21. Flowers and fruit in simple fascicles lacking a common "peduncle" 22
22. Leaves 4–7 cm. long, 1.5–2.0 cm. wide, pubescent above when very young (later glabrous), densely ferrugineous-tomentose below ..... 20. *F. ferruginea*
22. Leaves 13–17 cm. long, 4.0–8.5 cm. wide, glabrous above, pubescent on midrib below ..... 21. *F. Grisebachii*
23. Branchlets and leaves covered with a rufous-floccose fasciculate pubescence ..... 22. *F. arbutifolia*
23. Branchlets and leaves covered with a simple pubescence 23. *F. reticulata*
24. Calyx-lobes glabrous 25
24. Calyx-lobes pubescent 29
25. Flowers sessile; leaves and branchlets densely rufous-tomentose ..... 24. *F. sericea*
25. Flowers pedicellate; leaves and branchlets glabrous or sparingly pubescent at first, later glabrous 26

26. Plants glabrous throughout (except bracts at base of pedicel); leaves 8–10 cm. long with 30 or more pairs of veins arranged in close succession ..... 25. *F. Wawrai*
26. Branchlets, leaves, petioles and pedicels pubescent at first, later glabrous; leaves 5–9 cm. long with 20 or less pairs of veins 27

27. Leaves up to 10 cm. long, 2.5–3.0 cm. wide ..... 26. *F. Karsteniana*
27. Leaves 3–5 cm. long, 2 cm. or less wide 28

28. Leaves with 15–20 pairs of veins, in strict succession, ca. 1 mm. apart .....27. *F. parva*
28. Leaves with 6–9 pairs of lateral veins, laxly arranged and as much as 5 mm. apart ..... 28. *F. euryoides*

29. Flowers sessile ..... 29. *F. tomentosa*
29. Flowers pedicellate 30

30. Flowers and fruit borne in fascicles on abbreviated flowering branchlets of more than a single year's duration 31
30. Flowers and fruit in simple fascicles, lacking a common "peduncle" 32

31. Leaves and branchlets covered with a dense short, erect pubescence, not long, appressed silky; longitudinal striations absent on leaves ..... 30. *F. lanata*
31. Leaves and branchlets covered with a silky sericeous pubescence; longitudinal striations on leaves ..... 31. *F. roraimensis*

32. Flowering parts large for the genus; calyx-lobes 6–7 mm. long, 7–9 mm. wide; petals 11–12 mm. long, 6.0–8.5 mm. wide ..... 32. *F. canescens*
32. Flowering parts normal in size; calyx-lobes not over 3–4 mm. long; petals considerably less than 10 mm. long 33

33. Pedicels up to 5 or 6 mm. long, longer than the calyx-lobes; ovary and fruit globose; pubescence lightly sericeous; veining pronounced on upper surface of leaves 33. *F. candicans*
33. Pedicels 1–3 mm. long, usually shorter than calyx-lobes; ovary and fruit conic; pubescence densely sericeous; veining rather inobscure on upper surface of leaves .. 34. *F. chrysophylla*

1. **Freziera cordata** Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8:** 334. 1847. — Choisy in Mém. Soc. Phys. Genève **14:** 112. 1855. — Urban in Bot. Jahrb. **21:** 541. 1896. — Duss, Fl. Phan. Antill. Franç. 96. 1897.

Eurya cordata Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6:** 190. 1893. — Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21:** 149. 1925.

DISTRIBUTION: West Indies (Martinique) and ? Venezuela.

MARTINIQUE: Montagne Pelée, environs du lac des Palmistes, alt. 900–1200 m., *Père A. Duss 72* (MO, NY, US), *576, 4039*, 1882–1899 (arbuste droit, ou tortueux, ou presque sans tige et à branches touchant presque la terre).

VENEZUELA: Maracaibo, *A. Plée s.n.* (TYPE, Paris, Mus d'Hist. Nat.; photo FM).

This species is characterized by the large (up to 13 cm. long and 7 cm. wide), coriaceous, cordate leaves, the veins (ca. 20 pairs) deeply impressed on the upper surface, highly raised on the lower surface. The lateral veins are unusually large. At the base, the midrib is quite thick but decreases in size as it approaches the apex. The veins appear as part of a huge cable (midrib) at the base. As they approach the apex, the veins seem to detach themselves and swing toward the sharply serrate margin.

The comparatively large flowers on short pedicels (2–3 mm.) are nearly obscured by the leaf-auricles. The calyx-lobes, at first covered with a dense fulvous pubescence, become glabrescent, are quite rotundate (6 mm. × 6 mm.). The five petals are approximately 1 cm. long and the stamens number ca. 15. The ovary is conic-ovate, tapering into the style and finally terminated by a 3-parted stigma.

The type of *F. cordata* was supposedly collected at Maracaibo, Venezuela, by A. Plée. Except for this single collection, all other specimens have been collected from Mt. Pelée on the island of Martinique. The collector and student Père A. Duss gives the impression that the species is endemic to Mt. Pelée. Since A. Plée collected in Martinique as well as several other West Indian Islands, I feel quite certain the type was collected from the same locality visited by Père Duss — which may be tragic — for a brief note on a specimen in the New York Botanical Garden, "cette belle plant a du disparaître sous les laves," may mean that the whole species was destroyed by the volcanic eruption of Mt. Pelée in 1902.

2. **Freziera hirsuta** Smith in Rees, Cyclop. **15:** no. 4. 1810.

Freziera undulata var. *β hirsuta* Urban in Bot. Jahrb. **21:** 543. 1896.

DISTRIBUTION: West Indies (St. Vincent, Grenada).

ST. VINCENT: in monte Soufrière, *H. Eggers 6908* (AA, G) January 10, 1890. GRENADA: Mt. St. Catharine, alt. 750 m., *H. Eggers 6189* (AA, US), December 1889 (tree 20 ft. with white flowers). — St. Georges, Grand Etang woods, *W. E. Broadway s.n.* (G, MO, NY).

This species resembles *F. undulata* Swartz in the obovate-oblong leaves (up to 10 cm. long; 2.5–4 cm. wide), the undulate margin and small flowers. Separating it from *F. undulata* and the var. *elegans* is the dense, persistent, yellow-brown, villous pubescence found on the branches, petioles, peduncles and bracteoles.

This species has been recorded as ranging throughout the lesser

Antilles up into Cuba. However, since it has been so often confused with *F. Grisebachii* and *F. undulata,* it seems best to restrict its range until actual specimens representing this species have been examined from the islands formerly recorded.

3. **Freziera undulata** (Swartz) Swartz, Fl. Ind. Occ. **2**: 974. 1800. — Willdenow, Sp. Pl. **2**[2]: 1179. 1800. — Smith in Rees, Cyclop. **15**: no. 2. 1810. — De Candolle Prodr. **1**: 524. 1824. — Sprengel, Syst. Veg. **2**: 596. 1825. — Spach, Hist. Nat. Vég. **4**: 65. 1835. — Urban in Bot. Jahrb. **21**: 542. 1896. — Duss, Fl. Phan. Antill. Franç. 97. 1897. — Boldingh, Fl. Eustatius, Saba and St. Martin, **1**: 134. 1909; Fl. Nederl. West-Indische Eil. 286. 1913.

Eroteum undulatum Swartz, Prodr. 85. 1788. — Vahl, Symb. **2**: 61. 1791.

Eurya undulata Blume, Mus. Bot. Lugd.-Bat. **2**: 105. 1856. — Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893.

Freziera Perrottetiana Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8**: 332. 1847, fide Urban.

Freziera salicifolia Choisy in Mém. Soc. Phys. Genève **14**: 122. 1855.

Freziera salicifolia Choisy var. *undulata* (Swartz) Wawra in Fl. Bras. **12**[1]: 283. 1886.

DISTRIBUTION: West Indies (St. Kitts, Guadeloupe, Martinique, Dominica, Trinidad, Saba, Montserrat).

ST. KITTS: *Masson s.n.* (probably ISOTYPE, G). — Mountains above Lamberts, alt. 600 m., *H. Eggers s.n.* (US), Dec. 1882 (high tree). — Upper slopes of Mt. Misery, *N. L. Britton & J. F. Cowell 507* (NY, US), Sept.–Oct. 1901. DOMINICA: in silvis ad Lagunam Roseau, alt. 1000 m., *H. Eggers ed Toepffer 632* (G), Dec. 1881. — Hb. *Hooker s.n.* (NY). TRINIDAD: *Sieber 113* (G, NY). MARTINIQUE: *M. Hahn 119* (G), Feb. 1868. — Bois de la Calebasse et du Champflore, alt. 500–700 m., *Père A. Duss 71, 644, 4040* (NY, US), 1879–1899 (petit arbor elégant). — Bois du Matouba, alt. 600–900 m., *Père A. Duss 2988* (NY, US), *1892,* (petit arbor, droit ou tortueux). MONTSERRAT: Gages, near Soufrière, *J. A. Shafer 195* (NY, US), Jan. 23, 1907 (tree 4–5 m. with white fls., "mountain parrot"). SABA: mountains, alt. 800 m., *I. Boldingh 2211B* (NY), 1906.

This species is quite widely distributed throughout the Lesser Antilles. It is closely allied to *F. hirsuta* but is pubescent only on the very young or new growth, quickly becoming glabrous. The flowers are short-pedicellate.

Characterized by oblong-lanceolate or lanceolate, undulate margined leaves, unequal at the base, 5–15 cm. long and 2–4 cm. wide, the veins elevated on the upper surface. Flowers axillary, 2–5 per fascicle.

Pedicels ca. 4 mm., bracteoles obtuse, ± 1.5 mm. long and wide. Calyx-lobes 5, rounded, subequal, 1.5–2.0 mm. long, ca. 1.5 mm. wide. Petals 5, acuminate, white, 5–6 mm. long. Stamens ca. 20, the filaments 1.0–1.5 mm. long, the anthers 1.2–1.7 mm. long, ovary ovate, 3-locular, attenuated into style. Style 1.5–2.0 mm. long, about equalling the ovary in length, entire, crowned by a 3-parted stigma. Fruit globose or ovoid-conic.

3a. **Freziera undulata** Swartz var. **elegans** (Tulasne) Krug & Urban in Bot. Jahrb. **21**: 543. 1896.

Freziera elegans Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8**: 336. 1847. — Walpers, Ann. **1**: 119. 1848.

Cleyera elegans Choisy in Mém. Soc. Phys. Genève, **14**: 110. 1855.

DISTRIBUTION: West Indies (Guadeloupe, Martinique, Dominica).

GUADELOUPE: Lac Flammarion near Soufrière, humid transitional forest, very windy, alt. 1100 m., *H. Stehlé 460* (NY), April 22, 1936 (very rare); *1517* (US), Feb. 8, 1937. — Savane a Mulets et Savane aux Ananas, alt. 900–1000 m., *Père A. Duss 3426* (NY, US), 1894 (1.5–2.5 m. tall). MARTINIQUE: Pitons-du-Carbet, montagne Pelée, *Père A. Duss 644a* (NY, US), 1882 (small tree or large bush, rare). DOMINICA: Trois Pitons, *F. E. Lloyd 756* (NY), 1903.

The variety is characterized by the leaves being smaller, more delicately patterned, elliptic, and narrower than in the type of the species. The leaves are equal or nearly equal at the base, and are seldom over 8 cm. long. In the ♂ flowers the bracteoles are about 1.8 mm. long and 1.5 mm. wide and scarious margined. The five sepals are a little larger, about 2 mm. or more long and nearly as wide, ciliolate. The five petals are quite uniform in size measuring ca. 6.0 × 3.5 mm., acuminate at the apex, involute. The stamens (15–20) have filaments 1.2–1.7 mm. long and anthers 2.1–2.7 mm. long. Both the filaments and anthers are somewhat longer than those found in the species. The ovary is conic-ovate and tapers directly into the style with no point of differentiation. Many ovules are to be found in the three cells of the ovary, which, as far as I can see, never develops. Urban suggests that the ♂ flowers drop soon after the pollen is developed. The stigma is closed rather than spreading as in the ♀ flowers and lacks a papillose, stigmatic surface.

The ♀ flowers are similar to the ♂ flowers except that the staminodia are undeveloped, with hardly any distinction between filament and anther. The ovary tapers into the style which is crowned by a 3-parted stigma.

4. **Freziera suberosa** Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8**: 330. 1847. — Triana & Planchon, op. cit., sér. 4, **18**: 264. 1862.

Eurya suberosa (Tul.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III, **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit., ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Dept. Tolima, Andes Mts., *J. Goudot s.n.* (photo and fragment of TYPE, FM), 1844.

Freziera suberosa is characterized by a hirsute, fissured, corky bark. The leaves are small (2.5 × 1.0 cm.), elliptic-oblong, widely revolute, obtuse at the apex, unequal at the base, glabrous above (even when young) except for the midrib which is tawny pubescent nearly the whole length, densely sericeous below; the petiole scarcely 2 mm. long, hirsute.

Since only a fragment of leaves and branchlets were available for study, the description of flower and fruit of the original author must suffice. The ♀ flowers axillary very often solitary, large, the peduncles long, hirsute; bracteoles subopposite, coriaceous, hirsute, keeled on the dorsal surface, fulvous; calyx-lobes 5, ovate-rotundate, coriaceous, concave, fulvous, 7–8 mm. long and 5–7 mm. wide; petals 5, glabrous ovate-rounded, imbricate in bud; staminodia 15–18 in a single series glabrous; ovary conical, 3–4 celled, glabrous, tapering into a short rigid style, which is terminated by 3 or 4 stigmas. Fruit globose, conic.

The very small leaves separate this species from all other known species of the genus. Tulasne and also Triana & Planchon compare the leaves of this species to those of *Buxus sempervirens*. The flowers are very large for the genus. The species must be rare. It seems, judging from the material deposited in American herbaria, to have been collected only once.

5. **Freziera angulosa** Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8**: 332. 1847.

Eurya angulosa (Tul.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III, **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit. ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Bolivia).

BOLIVIA. Dept. La Paz: Vicinity of Coroico, *Pentland 105* (photo of type, FM), 1839. — Mapiri, *A. M. Bang 1489* (AA, G, MO, NY, US), July–Aug. 1892. — Mapiri, alt. 600 m., *G. H. H. Tate 476* (NY), Mar.–Apr. 1926. — Copacabana, about 10 km. south of Mapiri, alt. 850–950 m., *B. A. Krukoff 11035* (AA, NY), Oct.–Nov. 1939 (tree 24 m.). — Valley of Tipuani, *H. A. Weddell s.n.* (FM) 1851. — Ticunhuaya, alt. 1500 m., *G. H. H. Tate 1105* (NY), Apr. 1926.

Branchlets angled, pubescent at first, later glabrous, leaves elliptic-oblong, coriaceous, 10–20 cm. long, 4–7 cm. wide, acuminate at apex, decidedly unequal and rounded at base, subsessile, shining, glabrous (pubescent below, at first), the margin lightly serrulate, the veins prominent on both surfaces. Flowers 4–6-fasciculate, axillary; pedicels very short (1–2 mm.), sericeous; bracteoles 2, deltoid, sepaloid, ca. 2.5 mm. long and wide, pubescent; calyx lobes 5, imbricate, concave, suborbicular, glabrous, ca. 4 mm. long and 3 mm. wide, the margin scarious; petals 5, ca. 6 mm. long, unequal, width 3–5 mm.; stamens ca. 20, ca. 3.5 mm. long, the filaments 2 mm. long, the anthers linear, flat, 1.5 mm. long; ovary conic, tapering into brief style, 3-celled, multi-ovulate. Fruit globose, 5–6 mm. diam., 3-celled, many-seeded.

Like *F. Hieronymi*, this species is characterized by glabrous, angled branchlets, soon becoming terete. Also, in both species, the leaves are unequal at the base, more pronounced in *F. angulosa*. However, in *F. Hieronymi* the leaves are long-petioled (1.5–2.0 cm.) while in this species the leaves are sessile, or, if petioled, very slightly so.

For some unknown reason, most herbarium material of this species has been identified as *F. subintegrifolia* and as such has generally been known. Whereas the leaves in this species are sessile or subsessile, the leaves in *F. subintegrifolia* are long-petiolate (2.5–3.0 cm. long), and much wider (up to 10 cm.). These two characters will immediately separate the two.

6. **Freziera Hieronymi** Kobuski in Ann. Missouri Bot. Gard. **25**: 355. 1938.

Eurya nitida Hieronymus in Bot. Jahrb. **20**, Beibl. **49**: 50. 1895. — Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149. 1925. — Non Korthals (1840).

DISTRIBUTION: South America (Colombia).

COLOMBIA: Prov. Antioquia, between Yolombó and Cancan, alt. 1500–2000 m., *F. C. Lehmann CCXVIII* (isotype of *Eurya nitida* Hieronymus, US; photo of Berlin type, G, FM), Sept. 1884. — Exact locality missing, *J. C. Mutis 4445* (US), *4600* (US), *4625* (FM, US).

Because of the existence of an earlier homonym, *Eurya nitida* Korthals (1840), a new name, *Freziera Hieronymi* was used when the transfer to *Freziera* was made in 1938. At that time, the name was erroneously recorded "Hieronyma" instead of *Hieronymi* as listed above.

This species is characterized by glabrous young branchlets, angled and narrowly subalate at first, finally becoming subterete. Leaves oblong-ovate, coriaceous, ca. 13–14 cm. long and 6–7 cm. wide, abruptly acumi-

nate at the apex, unequal and subrotund at the base, the margin serrate, the veins raised and reticulate on both surfaces, shining and glabrous above, pubescent on the veins below; petiole 1.5–2.0 cm. long, canaliculate, winged.

Flowers axillary, the fascicles 2–5-flowered, shortly pedicellate (1–2 mm. long, sericeo-pubescent to subglabrous), the bracteoles 2, suborbicular, ca. 2 mm. long, glabrous, the calyx-lobes 5, orbicular, ca. 2.5 cm. long, glabrous. According to Hieronymus (herbarium material in bud of fruit), the petals are crassulate, ovate, ca. 4–5 mm. long, glabrous, the stamens 10, with the anthers a trifle shorter than the filaments, the ovary glabrous, conic-ovoid 5-loculate, attenuated at the apex into a short style topped by a 5-parted stigma.

This species can be separated from *F. nervosa* by the angled, winged young branchlets, the 5-celled ovary, and the shining, coriaceous leaves.

Mutis 4625 varies from the other specimen in having ovate-lanceolate leaves.

7. **Freziera guatemalensis** (Donn. Sm.) Kobuski in Ann. Missouri Bot. Gard. **25**: 354. 1938.

Eurya guatemalensis Donnell Smith in Bot. Gaz. **46**: 109. 1908. — Standley in Publ. Field Mus. Nat. Hist. Bot. Ser. **8**: 317. 1931.

DISTRIBUTION: Central America (Guatemala, Republic of Honduras).

GUATEMALA: Dept. Alta Verapaz, Coban, alt. 1350 m., *H. von Tuerckheim II 1824* TYPE (FM, G, MO, NY, US), June 1907. — Dept. San Marcos, near Finca El Porvenir, alt. 1400–1700 m., *J. A. Steyermark 37049*, *37272* (FM), Mar. 1–8, 1940 (flowers creamy; "durazno de monte"). HONDURAS: in forest near the summit of the range above El Alchote, in cloud zone, above the plains of Siguatepeque, alt. 1800 m., *T. G. Yuncker, R. F. Dawson & H. R. Youse 6161* (FM, MO, NY, US) July 28, 1936 (small tree 4.5 m.; fls. white, fleshy; leaves shiny green above, brown-wooly beneath).

This species is characterized by Donnell-Smith as having lanceolate leaves, shining above, ferrugineous-tomentose beneath, acuminate at the apex, unequal, acute or subacute at the base, the margin entire. The flowers pedicellate, in fascicles, on a common peduncle. This applies very well for the type. However, later collections (*Steyermark 37049* and *37272*) show the margins to be serrulate as well as entire, and the tomentose pubescence to be tawny, as well as ferrugineous.

The two nearest relatives are *F. candicans* and *F. lancifolia*. *Freziera candicans*, like *F. guatemalensis*, possesses both entire and serrulate

leaves but it lacks the abbreviated peduncle in the inflorescence, has an equilateral leaf-base and a conspicuous, more delicate pattern of veining on the upper surface of the leaf. *Freziera lancifolia,* also like *F. guatemalensis,* has the abbreviated "flowering branch" or common peduncle. This is not as well developed in the latter species but careful examination shows an initial development. However, *F. lancifolia* differs from *F. guatemalensis* in having the under surface of the leaves nearly glabrous, a rounded and equilateral leaf-base and the pedicels considerably longer.

8. **Freziera macrophylla** Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8**: 330. 1842.

Eurya macrophylla (Tul.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit., ed. 2, **21**: 148. 1925.

DISTRIBUTION: Mexico (Oaxaca).

OAXACA: Locality lacking, *D. Franco s.n.* (photo of type, FM), 1842. — Teotalongo, *C. Liebmann 337,* in part (FM, US), Nov. 1842.

Freziera macrophylla, rightfully named because of its large leaves, reaches the northernmost range on the American continent. No other species of *Freziera,* except those in the West Indies, extends so far north. Besides the type, one other collection *Liebmann 337,* in part, has been collected in Oaxaca. About this latter number, there is some uncertainty. The uncertainty lies in the collector's number, not in the species. In several herbaria, are representatives of *Liebmann 337* which belong to *Cleyera cernua* supposedly collected at La Lagume in August 1842. *Liebmann 337* cited here under *Freziera macrophylla* is questionably labeled "?Teotalongo 11.42."

Branchlets and leaves (under surface) are covered with a very short, appressed, tawny pubescence. The leaves are linear-oblong, 20–25 cm. long and 5–6 cm. wide, acuminate at the apex, rotund and unequal at the base, glabrous above (except for a line of tawny pubescence extending along the entire midrib), short appressed tawny pubescent below, the primary veins sharply elevated below, 20–25 pairs, the margin plane, serrate, the petiole winged, about 1 cm. long, pubescent. Flowers axillary, fasciculate (4–6), shortly pedicellate (2–4 mm.), the bracteoles broadly ovate, ca. 1.5 mm. long, obtuse at the apex, pubescent, coriaceous; calyx-lobes 5, suborbicular, imbricate, coriaceous, 3–4 mm. long, the outer lobes pubescent on the dorsal surface, the inner ones glabrous; petals 5, glabrous, imbricate in the bud, broadly ovate to ovate-oblong, twice as long as the calyx-lobes; stamens ca. 15 (not seen), unequal, adnate to the base of the corolla. According to Tulasne, the ovary is glabrous, 5-celled, the fruit is globose, 5-celled, multi-ovulate.

9. **Freziera Smithiana,** sp. nov.

Arbor ramulis teretibus brunnescentibus hornotinis dense fulvo-pilosulis, probabiliter mox glabrescentibus. Folia oblongo-ovata, coriacea, 20–24 cm. longa et 6.0–8.5 cm. lata, supra glabra (juventate fulvo-pubescentibus), subtus pubescentia, apice abrupte acuminata, basi subrotundata, distincte inaequalia, costa supra canaliculata, subtus ca. 3 mm. elevata, venis lateralibus 25–30 paribus undique prominentibus reticulatis margine serrulata, petiolis 3–4 cm. longis pubescentibus, alatis involutis. Flores axillares, 5–7-fasciculati; pedicelli fulvo-pubescentes, ad 7 mm. longi, apice bracteolis 2 oppositis sepaloideis suborbicularibus concavis dense fulvo-sericeis ca. 3 mm. longis latisque; sepala 5, imbricata, inaequalia, subrotundata, concava, dense hirsuta, exterioribus 5–6 mm. longis et ca. 5 mm. latis, margine anguste scariosis, interioribus ca. 6 mm. longis et ca. 5 mm. latis, margine 1.5 mm. scariosis; petala 5, imbricata, inaequalia, ca. 9 mm. longa et 6–7 mm. lata, apice subrotundata; stamina ca. 25, uniseriata, 3–4 mm. long, filamentis ca. 1 mm. longis claviformibus, antheris linearibus ca. 3 mm. longis apiculatis; ovarium (♂ fl.) ca. 5 mm. longum, basi 2 mm. diam., ad apicem attenuatum, tri-loculare, multo-ovulatum. Fructus ignotus.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Dept. Santander, vicinity of Las Vegas, Eastern Cordillera, in thickets, alt. 2600–3000 m., *E. P. Killip & A. C. Smith 15915* (AA, TYPE; G, NY, US), Dec. 1926 (tree).

The leaves of this species are very distinctive. Such features as the large size, the large number of showy lateral veins, the cross reticulations on the under surface, the tawny pubescence on both surfaces when very young, the long sturdy petiole and the difference of 8–10 mm. of the leaf-sides at the base cause this species to stand out from all others. The dense tawny pubescence on the pedicel, bracteoles and calyx, all are features of distinction. The absence of lenticels on the branchlets is an unusual feature. No pistillate flowers or fruit were available for study.

This species is named for Dr. A. C. Smith of the Arnold Arboretum Staff. He participated in the collection of the type specimen and early recognized the species as new.

10. **Freziera inaequilatera** Britton in Bull. Torrey Bot. Club **16**: 63. 1889.

Eurya inaequilatera (Britton) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149. 1925.

Eurya inaequalifolia Lingelsheim in Rep. Spec. Nov. **7**: 111. 1909. — Melchior in Engler & Prantl, l.c. — Syn. nov.

Freziera inaequalifolia (Lingelsh.) Kobuski in Ann. Missouri Bot. Gard. **25**: 354. 1938.

DISTRIBUTION: South America (Bolivia).

BOLIVIA. Dept. La Paz, Prov. Larecaja: Mapiri, alt. 750 m., *H. H. Rusby 2467,* TYPE (G, MO, NY, US), May 1886. — Mapiri Region, San Carlos, alt. 750 m., *O. Buchtien 1998* (isotypes of *Eurya inaequalifolia* Lingelsheim, NY, US), Sept. 1907; *O. Buchtien 1652* (G, NY), *1653* (FM, US), March 29, 1927 (tree 8 m.). — Copacabana, about 10 km. south of Mapiri, alt. 850–950 m., *B. A. Krukoff 11044* (AA, NY), Oct.–Nov. 1939 (tree 18 m.).

Trees with branchlets ferrugineous tomentose at first, later glabrescent. Leaves coriaceous, elliptic-lanceolate, (12–)16–20 cm. long, 4–6 cm. wide, sparsely pubescent above (especially on lower-half of midrib), ferrugineous tomentose below, acuminate at apex, rounded and unequal at base, margin serrulate, lateral veins (ca. 20 pr.) prominent below; petiole 1 cm. long, tomentose, winged. Flowers axillary, fascicles 3–7-flowered; pedicels tomentose, varying lengths, up to 7 mm. long; bracteoles 2, deltoid, 3.0–3.5 mm. long, 3.5–4.0 mm. wide, tomentose, concave, pergamentaceous, apiculate; calyx-lobes 5, imbricate, subrotund, concave, pergamentaceous, ca. 5 mm. long, 4–5 mm. wide, outer 2 tomentose on entire dorsal surface, inner 3 tomentose only in center of dorsal surface, margins glabrous, membranaceous; petals 5, imbricate, ca. 6 mm. long, 3 mm. wide at base, tapering toward apex, lower half membranaceous, upper half hard, somewhat sepaloid in texture; stamens 20+, ca. 3 mm. long, filaments ca. 1.5 mm. long, thick, attenuated at point of union with anther, the anthers somewhat hastate, apiculate; ovary glabrous, conic, tapering into style, ca. 3 mm. long, 3-celled, multi-ovulate. Fruit globose, 5–7 mm. diam., many-seeded.

As the name suggests, the outstanding characteristic of this species is the unequal sides of the leaves. At the base, there is a variation of as much as 5 mm., making the leaf appear (1.5–2.0 cm.) more greatly petiolate than is actually (1.0–1.5 cm.) the case. This character plus the very dense ferrugineous tomentose pubescence on the branchlets, leaves, pedicels, bracteoles and calyx are the major gross characters which separate this species from *Freziera subintegrifolia,* its nearest relative.

11. **Freziera Friedrichsthaliana** (Szyszylowicz) Kobuski in Ann. Missouri Bot. Gard. **25**: 354. 1938.

Eurya Friedrichsthaliana Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit. ed. 2, **21**: 148. 1925.

DISTRIBUTION: Central America (Guatemala, Nicaragua).

GUATEMALA: Exact locality missing, *Friedrichsthal 996* (TYPE, Berlin; photo and fragment, FM). NICARAGUA: exact locality lacking, *G. Wright s.n.* (G, US), 1853–1856. — Summit of Mt. Mombacho, near Grenada, in meadow in rain-forest, alt. 1600 m., *V. Grant 808* (AA), Dec. 24, 1940 (spreading tree 8 m. high with white flowers).

The only references made to this species seem to be in the two keys in Engler & Prantl's, Nat. Pflanzenfam., first by Szyszylowicz in 1893 and later, in the second edition by Melchior (1925). A complete description follows: Trees or shrubs with strong vigorous glabrous reddish brown branchlets, in very young stage somewhat pubescent. Leaves unusually long-petiolate with the petioles 4–5 cm. long, glabrous, lightly winged on dorsal side; the leaf-blades (10–)14–16 cm. long giving an overall measurement of 18–21 cm. long, 5–7 cm. wide, subcoriaceous, ovate, glabrous (pubescent while unfolding), acuminate at apex, obtusely cuneate at base, delicately patterned on undersurface with many (25+) pairs of reddish lateral veins and cross veins, the margin sharply serrate. Flowers axillary, 3–5-fasciculate; pedicels ca. 5 mm. long, hirsute, glabrous, 3 mm. long; calyx-lobes 5, imbricate glabrous, pergamentaceous, suborbicular, ca. 4 mm. long, 3.5–4.0 mm. broad, concave; petals 5, imbricate, 6 mm. long, 4 mm. at middle, tapering to 1–2 mm. at apex, membranaceous at base, somewhat brittle and subinvolute at apex; ovary glabrous, conic, ca. 2 mm. long, 3-celled, multi-ovulate, tapering into very short (0.5 mm.) style, surrounded at base by a single series of staminodia; stigma 3-parted. Fruit globose, glabrous, 5 mm. diam., many-seeded.

This species stands alone because of its long petiole (5 cm.), probably, by far, the longest in the genus. The sharp serration of the leaf is another feature which makes it unusual.

12. **Freziera spathulifolia** (Melchior) Kobuski in Ann. Missouri Bot. Gard. **25**: 335. 1938.

Eurya spathulifolia Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Peru).

PERU: Precise locality lacking, *A. Weberbauer 3423* (photo of type, AA, FM, G).

This species can easily be recognized by the distinctly spathulate leaves, rounded or obtuse at the apex and tapering gradually at the base. This type of leaf is most unusual in the genus. Melchior (1925) merely

recorded this species as new in Engler & Prantl (l.c.), and except for his notes in a key, no description has ever been published. The following description is compiled from a photograph of the type.

Tree or shrub; branchlets pubescent at first, later glabrescent. Leaves coriaceous, oblong-spathulate, 5.0–7.5 cm. long, 2.0–2.7 cm. wide, rounded or obtuse at apex, tapering gradually at base into a broadly winged petiole (1.5–1.7 cm. long) or perhaps, according to interpretation, a petiole 2–3 mm. long, glabrous, shining above, pubescent below (pubescence appears quite dense in photograph), the margin serrulate. Flowers axillary, in fascicles of 1–4; pedicels 3–4 mm. long, appear to be pubescent; bracteoles 2, suborbicular, sepaloid, ca. 1.5 mm. long, appear to be pubescent; calyx-lobes 5, imbricate, suborbicular, appear to be glabrous; petals 5, ca. 5–6 mm. long, tapering at apex; stigma (attached to fruit) 3-parted; ovary 3-celled (assumption drawn from stigma). Fruit globose, glabrous, 5–6 mm. diameter.

13. **Freziera longipes** Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8**: 327. 1847. — Triana & Planchon, op. cit. sér. 4, **18**: 264. 1862.

Lettsomia longipes (Tulasne) Choisy in Mém. Soc. Phys. Genève **14**: 123. 1855.

Eurya longipes (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior, op. cit. ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Dept. Cundinamarca, Salto de Tequendama, *J. Goudot s.n.* (TYPE, Herb. Mus. Paris; photo FM). — Locality dubious, *Bro. Ariste-Joseph B-142* (US), 1921. — Dept. Magdalena, Sierra de San Lorenzo, dry forest, alt. 2100 m., *H. H. Smith 1753* (NY), Mar. 10, 1899.

Freziera longipes is characterized by large, thick, ovate leaves measuring up to 15 cm. long and usually 7–8 cm. wide with a long petiole which measures 3 cm. and is up to 4 mm. thick. The leaf-base is rounded or obtuse. The pubescence on the under surface of the leaf is so lanuginose that the serrulate margin appears entire. The flowers are large and sessile in the axils of the leaves. The calyx-lobes are glabrous, subrotund, ca. 7–8 mm. long and wide. The petals are large, about twice as long as the calyx-lobes. The ovary is five-celled.

The species can be separated from *F. tomentosa,* its nearest relative, by wide, thick-petioled leaves, rounded or broadly obtuse at the base, larger flowers, and glabrous calyx-lobes. *Freziera tomentosa* has sericeous calyx-lobes, which appear as though they might become glabrescent, much narrower leaves tapering at both ends, and more slender petioles.

14. **Freziera calophylla** Triana & Planchon in Ann. Sci. Nat. Bot. sér. 4, **18**: 261. 1862.

Eurya calophylla (Tr. & Pl.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit., ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Dept. Antioquia, San Julian, in forest, alt. 1800 m., *J. Triana s.n.* (photo of type, FM).

Since only a photograph of the type is available for studying this species, one must depend almost entirely on the original description for details. The species is very outstanding and should be recognized by the leaf characters alone. The authors state that the specimen comes from a beautiful tree of medium height which is glabrous. While these authors are usually very careful in mentioning pubescence, and no mention is made of pubescence throughout the entire description, yet Melchior (l.c.) in his key intimates that the under side of the leaf is thick silky-pubescent and also that the calyx is pubescent. Examining the photograph with a hand lens one is inclined to discredit Melchior's observations.

The leaves appear oblong-elliptic, chartaceous, are 20–25 cm. long, 8–9 cm. wide, glabrous, short-pointed at the apex, subrotund at the base, tapering into a short petiole (ca. 5 mm.), the margin serrulate; the midrib above is flat, the veins below are prominent and reticulate. Only staminate flowers were seen by the authors. They remark that the flowers are axillary, fasciculate, very shortly pedicellate, the corolla longer than the calyx, the stamens about 30, the ovary 3–5-celled, conical, tapering through the style to the stigma which they mention as 3–5-dentate.

15. **Freziera nervosa** Humboldt & Bonpland, Pl. Aequin. **1**: 31, t. 9. 1808. — Smith in Rees, Cyclop. **15**: no. 8. 1810. — De Candolle, Prodr. **1**: 525. 1824. — Sprengel, Syst. Veg. **2**: 596. 1825. — Spach, Hist. Veg. **4**: 65. 1835. — Triana & Planchon in Ann. Sci. Nat. sér. 4, **18**: 262. 1862.

Eurya nervosa (H. & B.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III, **6**: 190. 1893. — Hieronymus in Bot. Jahrb. **20**, Beibl. **49**: 49. 1895.

Eurya Lehmannii Hieronymus in Bot. Jahrb. **20**, Beibl. **49**: 49. 1895. — Syn. nov.

Freziera Lehmannii (Hieronymus) Kobuski in Ann. Missouri Bot. Gard. **25**: 354. 1938. — Syn. nov.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Dept. Nariño, vicinity of Pasto, *A. Bonpland s.n.* (fragment of type, FM). — Dept. El Cauca, dense damp forests in highlands of Popayán, alt. 1600–2200 m., *F. C. Lehmann B.T.427* (AA, G, NY), *4777* (isotype of *Eurya Lehmannii* FM, G, US), *4449* (FM), *7879* (FM, US). — Dept. El Cauca, Popayán, alt. 1760 m., *E. Pérez Arbeláez & J. Cuatrecasas 6035* (US), July 13, 1939 (large tree).

Freziera nervosa is characterized by membranaceous or submembranaceous leaves, glabrous above, pubescent below, with many pairs of conspicuous lateral veins. The flowers are axillary in fascicles up to seven; pedicels hirsute, 5–8 mm. long; bracteoles deltoid, sepaloid, unequal, 1.2–1.5 mm. long and as broad, pilose on the dorsal surface; calyx-lobes 5, small, 2.5–2.7 mm. long and nearly as broad, glabrous, concave, subrotund, scarious-margined and ciliolate; petals 5, ca. 5 mm. long and 2.5–4.0 mm. wide at the base, tapering to less than 1 mm. at the subinvolute apex, the lower half membranaceous, the upper half somewhat thicker; ovary glabrous, ovoid, ca. 2 mm. long, tapering in a short style less than 1 mm. long which is topped by a three-parted spreading stigma nearly 0.5 mm. long and wider than that of other species of *Freziera*.

Hieronymus separated *Eurya Lehmannii* from *F. nervosa* as follows: "Species *E. nervosae* (Humb.-Bonpl.) Szysz. affinis, differt ramulis novellis, petiolis, pedicellis indumento obtectis, petiolis paulo longioribus, floribus paulo majoribus etc." *Freziera nervosa* is pubescent on the young branchlets, petioles and pedicels. There is a variation in degree of pubescence but hardly enough to warrant specific delimitation. Also, the small variation in size of petioles and flowers mentioned by Hieronymus is negligible.

The only difference I can note is a smaller number of veins present in the leaves, which are, perhaps, a little more rotund at the base.

16. **Freziera verrucosa** (Hieronymus) Kobuski in Ann. Missouri Bot. Gard. **25**: 355. 1938.

Eurya verrucosa Hieronymus in Bot. Jahrb. **20**, Beibl. **49**: 51. 1895. — Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Ecuador).

ECUADOR: Prov. Azuay, western slope of the West Andes of Cuenca, in dense forests around Yerba-buenas and Molleturo, alt. 2400–2800 m., *F. C. Lehmann 5656* (TYPE, Berlin; isotypes FM, G, US) (tree to 10 m. with large, close crown; leaves thick, robust, almost leathery, shiny with brown petioles and veins; flowers yellow-white.) — Prov. Chimborazo, Riobamba, outer slopes of Western Cordillera, alt. 2500 m., *A. Rimbach 73* (AA), Nov. 1931, *121* (AA, FM, NY, US), Feb. 22, 1932 (middle-

sized forest tree; bark rather smooth, light gray with white lenticels; flowers small, faintly scented, corolla white; vernacular name "huishcaparun"). — In Andes, *R. Spruce 5032* (NY), 1857–1859. — Prov. Tungurahua, *H. Sydow 533* (US), Dec. 14, 1937.

This species is characterized by coriaceous ovate leaves up to 18 cm. long and 6 cm. wide, scattered silky-pubescent on the under surface, later glabrescent, glabrous above, long-petioled (2–3 cm.). Flowers axillary, 3–8-fasciculate, the pedicels pubescent, 7–10 mm. long; bracteoles 2, usually close to calyx-lobes and simulating them (occasionally 1 bracteole found lower on pedicel in *Rimbach 121*); calyx-lobes 5, imbricate, suborbicular, ca. 4 mm. long, 4–5 mm. wide, concave, glabrous; petals 5, white, 9 mm. long, 4–5 mm. wide at base, tapering toward involute apex, lower third lighter in color and texture; staminodia 25–30, ca. 3 mm. long; ovary globose, ca. 4 mm. long, 5-celled, many-ovuled, the style 1.5–2.0 mm. long, the stigma distinctly 5-parted, each branch nearly 1 mm. long. Fruit not seen.

Freziera verrucosa is most closely allied to *F. Hieronymi* and *F. subintegrifolia*. All three are characterized by shining, ovate, glabrous leaves with long (2–3 cm.) petioles. From both species *F. verrucosa* can be separated by the glabrous, long-pedicelled (up to 10 mm.) flowers. In both of the other species the pedicels are very short, glabrous in *F. Hieronymi* and pubescent in *F. subintegrifolia*. *Freziera verrucosa* and *F. Hieronymi* have coriaceous, serrulate and less broadly ovate leaves (not over 6 cm. wide), while *F. subintegrifolia* has membranaceous, entire or subentire and more broadly (up to 10 cm.) ovate leaves.

The leaves of the type of this species are less silky-pubescent, and generally shorter than the two specimens collected by Rimbach. As a result, the Rimbach numbers appear to represent a distinct species. However, on close examination, the constant flower characters prove to be the same and the leaves present no really stable characters for separation.

17. **Freziera subintegrifolia** (Rusby) Kobuski in Ann. Missouri Bot. Gard. **25**: 355. 1938.

Eroteum (*Erotium*) *subintegrifolium* Rusby in Mem. Torrey Bot. Club **3**, no. 3: 9. 1893.

Eurya subintegrifolium (Rusby) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149. 1925.

DISTRIBUTION: Bolivia.

BOLIVIA: Yungas, *A. M. Bang 496* TYPE (FM, G, MO, US), 1890.

This species is represented only by the single collection cited. The leaves are outstanding because of the extreme width (up to 10 cm.), the

long petioles (2.5–3.0 cm. long), the truncate or rounded base and the nearly entire margin. In addition, the leaves appear somewhat membranaceous, and are sparsely pubescent (close-lying, white, fine, silky) when young, later becoming glabrous. The very short pedicels (2–3 mm. or less), and the bracteoles are pubescent while the calyx-lobes are glabrous and ciliolate.

Closely allied to this species is *F. Hieronymi,* which can be separated by the less broadly ovate leaves (not over 6 cm. wide). These leaves are broadly cuneate and slightly unequal at the base and serrulate on the margin. The pedicels (very short) and all the flower parts are strictly glabrous. The internodes are winged.

Freziera verrucosa belongs with these species but can be quickly separated from both by the long-pedicelled (up to 10 mm.) flowers. These pedicels add strikingly to the appearance of the species considering the fact that up to 8 flowers are often found in a single fascicle.

18. **Freziera caloneura,** sp. nov.

Arbor parva, 6-metralis, cortice brunneo valde lenticellato rimoso, ramulis brunneis glabris lenticellatis. Folia oblongo-ovata vel ovato-elliptica, coriacea, 22–29 cm. longa et 7.0–10.5 cm. lata, glabra (juventate exceptis), apice abrupte sed longe acuminata, basi aequalia et rotundata, costa supra canaliculata, violacea (fide collectoris), subtus ca. 3 mm. elevata, viridia, venis lateralibus crassis 30–35 paribus undique prominentibus, margine minute serrulata vel subintegra, revoluta, petiolis 3.0–3.5 cm. longis glabris alatis involutis glabris (juventate pubescentibus). Flores ignoti. Fructus globosus, 8–10 mm. diam. (probabiliter immaturus), 5-locularis, multi-seminatus; pedicelli 7–10 mm. longi, glabri, bracteis linearibus 5–8 mm. longis et ca. 3 mm. latis pubescentibus, bracteolis 2, glabris 8–10 mm. longis et 7–8 mm. latis apice subrotundatis, basi contiguis; sepala 5, imbricata, inaequalia, subrotundata, concava, pergamentacea, glabra, ca. 7 mm. longa et lata.

Distribution: South America (Bolivia).

Bolivia: Dept. Cochabamba, Prov. Chapare, Oncachaca, in forest, alt. 2200 m., *J. Steinbach 9475* (type AA; isotypes FM, NY), Feb. 28, 1929 (small tree 6 m., leaves dark green, shiny above, the midrib violet above, green below; fruiting calyx and bracteoles brown-violet-green; fruit dark green).

Freziera caloneura has several outstanding features which distinguish it from all other species in the genus. The leaves, largest in the genus (22–29 cm. long, 7.0–10.5 cm. wide), surpass both *F. Smithiana* and *F. macrophylla* in length and *F. subintegrifolia* in width. On the under

surface of the leaf, the lateral veins (30 or more pairs), arranged in close succession, swing boldly out and approach close to the margin before breaking toward the apex. The bracts at the base of the pedicel are seldom featured as distinctive. On this species they are linear and measure up to 8 mm. long and 3 mm. wide. The two bracteoles are contiguous or nearly so at the base and encircle the pedicel just below the calyx-lobes. Also, these bracteoles surpass the calyx-lobes in length. This is the only species in which this reversed situation occurs. Unfortunately, no petals or stamens are available for study. One might assume that the petals, when eventually collected, will measure 13–15 (or even more) millimeters. Since the fruit is definitely 5-celled, the stigma is probably 5-parted.

19. **Freziera lancifolia** (Standley) Kobuski in Ann. Missouri Bot. Gard. **25**: 354. 1938.

Eurya lancifolia Standley in Publ. Field Mus. Nat. Hist. Bot. Ser. **8**: 317. 1931.

DISTRIBUTION: Central America (British Honduras).

BRITISH HONDURAS: Middlesex, in forest on mountain side, alt. 75–120 m., *W. A. Schipp 455* (TYPE FM; isotypes AA, G, MO, NY), November 15, 1929 (tall tree 15 m.; wood yellow, close-grained; fruit yellow; rare).—Camp 36, British Honduras, in forest on mountain side, alt. 800 m., *W. A. Schipp 8–710* (FM), June 26, 1934 (rare tree 18 m. with cream colored flowers).

The important characteristics of this species are: tall tree with reddish brown branchlets pubescent at first, later glabrescent. Leaves with pubescent, lightly winged petiole 1.0–1.5 cm. long; leaf-blade lanceolate, glabrous on upper surface except for midrib, sparsely pubescent below, becoming glabrous except for midrib and principal veins, 10–14 cm. long, 3.0–4.5 cm. wide, acuminate at apex, rounded at base, the margin serrulate. Fruit axillary, in fascicles on abbreviated flowering stem or peduncle, glabrous, subglobose, ca. 7 mm. long, 3-celled, many-seeded; style persistent; stigma occasionally found, 3-parted; pedicel 3–5 mm. long, pubescent; bracteoles 2, sepaloid, suborbicular, sericeous, ca. 1.5 mm. long; calyx-lobes 5, imbricate, suborbicular, sericeous, ca. 3.0–3.5 mm. long.

This species is most closely related to *F. candicans* and *F. guatemalensis*. From the former it can be separated by its glabrous or nearly glabrous lower leaf-surface, rounded leaf-base and abbreviated peduncle. From *F. guatemalensis* it can be separated by the same glabrous under leaf-surface, the serrulate leaf-margin, and the equilateral leaf-base.

Only two collections, both by Schipp in British Honduras, have been recorded.

20. **Freziera ferruginea** Wawra in Martius, Fl. Bras. **12**[1]: 284. 1886.

Eurya ferruginea (Wawra) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit., ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Peru).

PERU: Dept. San Martín, near Guayrapurima Mt., near Tarapoto, *R. Spruce 4442* (isotypes, C, FM, NY), August 1856.

Branchlets terete, covered at first with a dense ferrugineous tomentum, later becoming glabrescent. Leaves oblong-ovate, coriaceous, 4–7 cm. long, 1.5–2.0 cm. wide, very young leaves pubescent above at vernation, later glabrous, shining, below covered with the same dense ferrugineous tomentum of branchlets, not becoming glabrous, obtuse pointed at apex, rounded at base, the margin serrulate, the lateral veins (15–20 pairs) impressed above, prominent below even through tomentum; petiole 4–7 mm. long, covered with same thick short ferrugineous tomentum. Flowers, axillary, fascicles 1–3-flowered (according to Wawra, dioecious); pedicels 2–4 mm. long, densely ferrugineous-tomentose; bracteoles minute, ca. 1.0–1.5 mm. long, densely tomentose; calyx-lobes 5, imbricate, concave, pergamentaceous, obtuse or subrotund at apex, ca. 2 mm. long, thickly tomentose on the dorsal surface; petals 5, seemingly free, 3.5–4.0 mm. long, 1.5–2.0 mm. wide, oblong, obtuse at apex, lower half membranaceous, upper half (exposed above calyx-lobes) thicker, simulating texture of calyx-lobes; staminodia none; ovary glabrous, conic to globose, tapering into the style, topped by 3-parted stigma, 2.75 mm. long (over all). Fruit not seen.

This species is outstanding because of its small evenly shaped leaves, covered by a deep ferrugineous tomentum. This tomentum is found also on young branchlets, pedicels, bracteoles and calyx-lobes. The flowers are small, the petals slightly exceeding the calyx-lobes in length and simulating the calyx-lobes in texture on their exposed portion.

21. **Freziera Grisebachii** Krug & Urban in Bot. Jahrb. **21**: 542. 1896.

Freziera hirsuta Grisebach, Cat. Pl. Cub. 36. 1866. — Non Smith (1810).
Eroteum hirsutum G. Maza in Anal. Hist. Nat. Madrid, **19**: 222. 1890.
Eurya Griesbachii Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148. 1925.

DISTRIBUTION: West Indies (Jamaica, Cuba).

JAMAICA: Tweedside, below Moody's Gap, alt. 1100 m., *W. Harris 5658* (iso-syntypes, AA, NY, US), March 19, 1895 (tree 10 m.); same locality, *W. Harris 6067* (iso-syntypes, NY, US), Nov. 14, 1895 (tree

13 m.). — Same locality, *N. L. Britton 3380* (NY), Sept. 10, 1908 (tree 15 m.). CUBA: Loma del Gato, Cobre Range of Sierra Maestra, alt. 900–1000 m., *Fre. Leon, Clement & M. Roca 9920* (NY), July–Aug. 1921 (tree 7–8 m. with large flowers). — Oriente, *C. Wright 49* (iso-syntypes, G, MO, NY), Dec. 7, 1856 (small tree 6 m. high with white flowers and dark red fruit).

A species closely related to *F. cordata* in size of flower but separated quickly by rounded or obtuse base of leaf. Related to *F. hirsuta* in tomentose pubescence but separated by larger flowers, fruit and leaves.

Trees 10–15 m. with straight, terete rufous-villous branchlets, not geniculate. Leaves distichous, glabrous above; pubescent on midrib below, ovate to oblong-lanceolate, 13–17 cm. long, 4.0–5.5 cm. wide, equal or subequal, rounded or obtuse at base, narrowly acuminate at apex, margin flat, serrate, 15–20 pairs of lateral veins, petiole 1–2 cm. Flowers in axils 2–3-fasciculate, bracteoles semiorbicular, 2–3 mm. long; 3.0–4.5 mm. wide, tomentose. Sepals 5, unequal, 4–5 mm. long, 3.0–4.5 mm. wide, pergamentaceous, tomentose. Petals 5, white, 5–6 mm. long. Staminodia in ♀ fl. uniseriate, ca. 25. Ovary narrowly conic-ovate tapering into a style crowned by 3-parted stigma, 3-celled, multiovulate. Fruit ca. 10 mm. long, 6–8 mm. diam., glabrous.

Because of the dense pubescence, this species has been confused with and often cited as *F. hirsuta* Smith. The latter species is not found in Cuba, or, as far as I know, in Jamaica.

22. **Frezieria arbutifolia** Triana & Planchon in Ann. Sci. Nat. Bot. sér. 4, **18**: 262. 1862.

Eurya arbutifolia (Tr. & Pl.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit., ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Dept. Antioquia, Manzanillo, alt. 2000 m., *J. Triana s.n.* (isotype, NY, photo and fragment, FM). — Dept. Antioquia, between Carolina and Santa Rosa, alt. 2400–2800 m., *F. C. Lehmann CCXXII* (US), Sept. 1884.

Young branchlets densely rufous-pubescent. Leaves elliptic-oblong, coriaceous, 8–12 cm. long, 3–4 cm. wide, rounded or obtuse at apex, rounded at base, serrate, shining above, rufous-pubescent (floccose-fasciculate) on the impressed midrib and veins, more pubescent below, veins prominent; petiole ca. 1 cm. long, canaliculate, pubescent, narrowly margined. Flowers axillary, 1–2-fasciculate; pedicels 1–2 cm. long, densely rufous-pubescent; bracteoles densely pubescent, sub-

orbicular, 2–3 mm. long and broad; calyx-lobes 5, densely pubescent, suborbicular, 4–5 mm. long and broad; petals (not seen) 5, oblong, longer than calyx; stamens ca. 20–30; ovary conic, glabrous, attenuated into a short style, 5-celled, multi-ovulate; stigma 4–5-parted.

This species is closely related to *F. reticulata,* from which it can be separated by the longer pedicelled (1–2 cm.) flowers usually one in the axil, occasionally two, the leaves more nearly elliptic in shape, more obovate than ovate-lanceolate (as in *F. reticulata*), and the unusual floccose-fasciculate pubescence.

23. **Freziera reticulata** Humboldt & Bonpland, Pl. Aequin. **1:** 22, t. 5. 1808. — Smith in Rees, Cyclop. **15:** no. 3, 1810. — De Candolle, Prodr. **1:** 525. 1824. — Sprengel, Syst. Veg. **2:** 596. 1825. — Spach, Hist. Nat. Vég. **4:** 64. 1835. — Triana & Planchon in Ann. Sci. Nat. Bot. sér. 4, **18:** 264. 1862.

Eurya reticulata Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III, **6:** 190. 1893. Non Korthals (1840).

Eurya Humboldtiana Blume, Mus. Bot. Lugd.-Bat. **2:** 105. 1856.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Dept. El Cauca, Almaguer, alt. 2260 m., *Humboldt & Bonpland s.n.* (Herb. Delessert, Genève, TYPE; Mus. Paris, isotype; photo and fragment, FM). — Paramo d' Achupallas, Andes de Pasto et Quindio, alt. 3000 m., *J. Triana s.n.* (NY). — San Pedro, *Fre. Tomás & Daniel 1307* (FM), Dec. 1937 ("cerezo del monte"). — Quindio, *Purdie s.n.* (G).

Freziera reticulata, as the name indicates, is characterized by outstandingly reticulate leaves. The veins, noticeably impressed on the upper surface, are sharply elevated below. The cross veins are also raised on the under surface, giving a net-like appearance to the leaf surface. A dense rufous tomentum covers the lower surface of the leaves and, even though thick, coriaceous, and lustrous the upper surface is also pubescent. This latter is an unusual character. A sharp, glandular serrulation further separates this species from its near relative *F. sericea.* The shape of the leaf might be termed wide ovate-lanceolate, up to 17 cm. long and 8 cm. wide, obtusely acuminate at the apex and rounded at the base. The petiole measures as much as 2 cm. long and is densely tomentose, narrowly winged, and involute.

The flowers (according to Humboldt and Bonpland) are white, axillary, and in fascicles up to five. The calyx, bracts and pedicels are densely tomentose. Since most of the specimens were in fruit, no accurate measurements of the corolla could be made from the material

at hand. The calyx-lobes are deltoid, approximately 6–7 mm. long and about as wide. The bracteoles nearly equal the calyx-lobes in size and appear very similar. Both the calyx-lobes and bracteoles are densely tomentose as well as the pedicels which vary in length up to 5 mm.

The fruits of the specimens examined were 5-celled.

23A. **Freziera reticulata** Humboldt & Bonpland var. **subintegrifolia** (Hieronymus) Kobuski in Ann. Missouri Bot. Gard. **25**: 355. 1938.

Eurya reticulata (H. & B.) Szyszylowicz var. *subintegrifolia* Hieronymus in Bot. Jahrb. **20**, Beibl. **49**: 51. 1895.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Dept. Antioquia, between Carolina and Santa Rosa, alt. 2400–2800 m., *F. C. Lehmann 4068* (US, isotype), Sept. 1884. — Dept. Antioquia, San Pedro, *Bros. Daniel & Tomas 1561* (US), Aug. 1938. — Precise locality lacking, *Bro. Apolinar-María 267* (FM).

This variety differs from the species in the narrower leaves (not over 5 cm. wide), the entire or nearly entire leaf-margins, the longer petioles (up to 3 cm.), and the many-flowered fascicles (up to 10, fide Hieronymus).

The pedicels seem shorter than those of the species, many appearing almost sessile. The bracteoles are deltoid, 5–6 mm. long and ca. 4 mm. wide. The calyx-lobes are only slightly larger than the bracteoles, 5.0–6.5 mm. long and 4.0–5.5 mm. wide, obtuse to deltoid. The petals measure ca. 7.5 mm. long and 3–4 mm. wide, are oblong, obtuse to acute at the apex, hardly joined at the base, more membranaceous at the base than nearer the apex. The ovary is conic-ovoid, 4 mm. long, 3 mm. diam., 5-celled, multi-ovulate. The style is almost negligible, while the stigma appears as hardly more than 5 minute deltoid points.

24. **Freziera sericea** Humboldt & Bonpland, Pl. Aequin. **1**: 29, t. 8. 1808. — Smith in Rees, Cyclop. **15**: no. 7. 1810. — De Candolle, Prodr. **1**: 525. 1824. — Sprengel, Syst. Veg. **2**: 596. 1825. — Spach, Hist. Nat. Vég. **4**: 65. 1835. — Triana & Planchon in Ann. Sci. Nat. Bot. sér. 4, **18**: 263. 1862. — Wawra in Martius, Fl. Bras. **12**[1]: 283. 1886.

Eurya sericea (H. & B.) Blume, Mus. Bot. Lugd.-Bat. **2**: 105. 1856. — Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Hieronymus in Bot. Jahrb. **20**, Beibl. **49**: 49. 1895. — Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Dept. Nariño, Pasto, *A. Bonpland s.n.* (photo of isotype,

FM). — Dept. Antioquia, near Amalfi, alt. 1700–2000 m., *F. C. Lehmann CCXXI* (US); *7878* (FM), Sept. 1884. — Dept. El Cauca, "La Gallera," Micay valley, forest near Río San Joaquin, alt. 1100–1300 m., *E. P. Killip 7802* (G, NY, US), June 1922 (tree). — Dept. El Cauca, Tetilla mountains near Popayán, alt. 1500–1700 m., *F. C. Lehmann 7693* (FM, G, US) (trees up to 10 m. with large open crowns; trunks rarely over 50 cm. diam.; leaves shiny, yellowish, dark green above, rusty brown pubescent below; flowers yellow-white). — Dept. El Cauca, forests of El Rosario, highlands of Popayán, alt. 1600–1800 m., *F. C. Lehmann B.T.436* (AA, G, NY).

Freziera sericea is characterized by a long silky appressed pubescence, (amber-brown in color) on the lower surface of the leaves, the young branchlets and the terminal buds. This pubescence simulates in texture and color that found on *Archboldiodendron*, a theaceous genus indigenous to New Guinea. Also characteristic to both are the longitudinal striations, apparent in the pubescence of the lower leaf surface, presumably caused by the close folds of the leaf in bud. The leaves are elliptic-lanceolate, coriaceous, acuminate, glabrous above, sericeous below, up to 15–16 cm. long and usually up to 4 cm. wide (in one instance wider), sessile or with a petiole shorter than the flower clusters. The flowers are axillary, sessile, the calyx-lobes glabrous. The fruit is 5-celled, many-seeded, and the stigma is 5-lobed.

Closely related are *F. chrysophylla, F. longipes, F. candicans* and *F. tomentosa*. All these species have the same type of pubescence on the under surface of the leaves, varying in degree and color. One species, *F. chrysophylla*, has even been united as a variety. The various difference between these species and their closest allies will be found discussed under the species in question.

25. **Freziera Wawrai** Urban in Bot. Jahrb. **21**: 544. 1896.

Freziera salicifolia Wawra in Martius, Fl. Bras. **12**[1]: 283. 1886. Non Choisy (1855).

Eurya Wawrai (Urban) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Peru).

PERU: Dept. San Martín, Tarapoto, Campana Mt., *R. Spruce 4359* (iso-syntypes G, NY), August 1856. — Near Tarapoto, in mountains along Mayo river, *R. Spruce 4841* (iso-syntypes, FM, G, NY), July August 1856.

The branchlet terete, glabrous. Leaves subcoriaceous, glabrous, lanceolate to subelliptic, 8–10 cm. long, 2–3 cm. wide, acute at apex,

cuneate at base, the veins 30 or more pairs arranged in close succession, prominent on both surfaces, the margin plane, serrulate; petiole 3–5 mm. long, glabrous. Flowers axillary, 2–5-fasciculate; bracts minute at base of pedicel, pubescent; pedicels glabrous, varying in length up to 4 mm.; bracteoles glabrous, inconspicuous, lying close to calyx, ca. 1 mm. long; calyx-lobes 5, suborbicular, glabrous, ca. 2 mm. long and broad, concave, not ciliolate; petals 5, linear, ca. 6 mm. long and 2 mm. or less wide, somewhat involute; no stamens or staminodia present; ovary glabrous, tapering from base gradually to stigma (including style), 3 mm. over all, 3-celled, many-seeded. Fruit not seen.

This species stands out from all other species of the genus in being glabrous throughout, except for the bracts at the base of the pedicels. As mentioned, the veining is prominent on both surfaces, the lateral veins, 30 or more pairs, rising in close succession from the midrib. For such small leaves (8–10 cm.), this feature is most noticeable.

The combination *F. Wawrai* was made by Urban in observations included in his studies of West Indian plants. For some unexplainable reason, this combination has not been recorded since, even in Index Kewensis. Melchior (l.c.) transferred the species to *Eurya* but made no mention of the original place of publication.

26. **Freziera Karsteniana** (Szyszylowicz) Kobuski in Ann. Missouri Bot. Gard. **25**: 354. 1938.

Eurya Karsteniana Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit. ed. 2, **21**: 148. 1925.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Locality unknown (cited by Szyszylowicz as Guatemala), *H. Karsten s.n.* (TYPE, Berlin, photo & fragment FM). — Locality unknown, *Purdie s.n.* (G).

Like *Freziera Friedrichsthaliana*, this species was proposed by Szyszylowicz (l.c.) in a key to the Central American species of the genus *Eurya*. No description, other than the key characters, accompanied the proposal and both species were attributed to Guatemala. Karsten, the collector, as far as I know, never collected outside of South America, most of his time and efforts being spent in Colombia and Venezuela. Hence, since the photograph* and fragment of the type, found in the Field Museum, match with *Purdie s.n.* collected in Colombia, I have no hesitancy in attributing this species to Colombia, rather than

*Accompanying the photograph is a note stating that the specimen is from Colombia, while on the fragment, a note states that it is from Venezuela. At any rate, on neither fragment nor photograph is there any mention of Guatemala.

Guatemala. A description, drawn up from *Purdie s.n.* (G) follows: Trees probably, with reddish brown branchlets, slightly pubescent at first, later glabrescent. Leaves subcoriaceous, ovate, pubescent at first, later glabrous, acute at apex (not acuminate), equilateral and cuneate at base, the widest portion close to base, 5–9 cm. long, 2.5–3.0 cm. wide, shining above, lighter green below, the margin serrulate; petiole pubescent, canaliculate, lightly winged, ca. 5 mm. long. Flowers axillary, small, 3–6-fasciculate; pedicels 3–4 mm. long, pubescent (probably glabrescent in fruit); bracteoles 2, slightly over 1 mm. long, suborbicular, pubescent; calyx-lobes 5, imbricate, glabrous, ca. 2 mm. long, suborbicular, membranaceous along margin, usually not ciliolate; petals 5, imbricate, 4–5 mm. long, 1.5–2.0 mm. wide, linear, revolute near apex; staminodia in a single series adhering to either corolla or ovary, 1 mm. long; ovary ca. 1 mm. long, ovate, tapering into broad style also 1 mm. long, 3-celled, multi-ovulate; stigma 3-parted. Fruit globose, 4–5 mm. diam., many seeded.

This species is one with smaller leaves and flowers but no other outstanding characters which cause it to stand out in the genus. Like many species of the Asiatic genus *Eurya*, it is difficult to key. Because of the lack of description and the error in geographic distribution, it has been disregarded in botanical literature to date.

Placed here dubiously is *E. P. Killip & A. C. Smith 15225* from Colombia, Dept. Santander, alt. 1500 m. The leaf tapers differently (a non-tangible character) from the typical species and is generally larger.

27. **Freziera parva**, sp. nov.

Frutex 1-metralis, ramulis teretibus brunneis lenticellatis pubescentibus. Folia elliptica vel elliptico-ovata, coriacea, 3–5 cm. longa et 1.5–2.0 cm. lata, apice obtusa, basi cuneata et aequalia, glabra (costa undique excepta), venis lateralibus 15–20 paribus undique elevatis, margine serrulata, petiolis 5–8 mm. longis alatis involutis pubescentibus. Flores axillares 1–2 (raro 3)-fasciculati; pedicelli 3–5 mm. longi, pilosi; bracteoli 2, minuti, glabri, deltoidei, 1.5 mm. longi et ca. 2 mm. lati; sepala 5, imbricata, subrotundata, concava, glabra, ca. 2.5 mm. longa et 3 mm. lata, ciliolata, interioribus petaloideis; petala 5, imbricata, elliptica, alba, concava, ca. 5 mm. longa et 2 mm. lata; staminodia ca. 20, uniseriata, ± 1 mm. longa; ovarium conico-globosum, apice attenuatum, glabrum, tri-loculare. Fructus immaturus.

Distribution: South America (Peru).

Peru: Dept. Amazonas, Prov. Bongara, between Jumbilla and San

Carlos, alt. 2900–3000 m., *A. Weberbauer 7152* (TYPE, G; isotypes, FM, US), June 1915 (shrub 1 m. high, with white flowers).

This species is closely related to *F. euryoides,* the following species. Both are distinctive for their small leaves and small flowering parts. Seldom over 5 cm. long and 2 cm. wide, the leaves of both are further characterized by having an obtuse, but not acuminate, apex and cuneate base. However, in *F. parva,* the leaves are traced by 15–20 pairs of veins arranged in close succession while in *F. euryoides,* only 6–9 pairs of veins can be observed. According to the collector this species is a shrub (1 m.), which is most unusual in the genus.

28. **Freziera euryoides,** sp. nov.

Planta lignosa, arbor ut videtur, ramulis teretibus brunnescentibus lenticellatis, hornotinis strigosis. Folia oblongo-obovata, 3–5 cm. longa et 1–2 cm. lata, chartacea vel subcoriacea, sparse strigosa, apice obtusa, basi in petiolum attenuata, margine serrulata, venis lateralibus paucis (ca. 6–9 paribus), petiolis 4–6 mm. longis strigosis alatis involutis. Flores axillares, 1–2-fasciculati; pedicelli 3–4 mm. longi, strigosi, bracteolis 2 sepaloideis sparse strigosis ca. 2 mm. longis et 1.5–2.0 mm. latis; sepala 5, imbricata, inaequalia, concava, subrotundata, glabra, ca. 3 mm. longa et lata; petala et stamina non visa; ovarium globosum, glabrum, tri-loculare, stylo brevi, ca. 1 mm. longo; stigmata tri-partita. Fructus immaturus globosus tri-loculatus.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Exact locality lacking, *J. C. Mutis 3706* (TYPE US), *2206* (US), *3707* (US).

Freziera euryoides, as the name signifies, simulates the genus *Eurya* in general appearance. No complete flowers were observed, yet one could not hesitate to describe the species from the fruit and persistent calyces, so distinct is it from all other species. The small leaves and flowers, as stated under the preceding species, are two of the outstanding characters which set it apart from most other species. Also, as mentioned before, the wide variation in veining distinguishes this species from *F. parva.*

29. **Freziera tomentosa** (Ruiz & Pavon), comb. nov.

Lettsomia tomentosa Ruiz & Pavon, Fl. Peruv. & Chil. Prodr. **4**: 77, t. 14. 1794; Syst. Veg. 134. 1798. — De Candolle, Prodr. **1**: 525. 1824. — Choisy in Mém. Soc. Phys. Genève **14**: 123. 1855.

Freziera Dombeyana Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8**: 329. 1847. — Syn. nov.

Lettsomia Dombeyana (Tul.) Choisy in Mém. Soc. Phys. Genève **14**: 123. 1855.

Eurya Dombeyana (Tul.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior, op. cit., ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Peru).

PERU: Exact locality lacking, *J. Pavon s.n.* (TYPE of *Lettsomia tomentosa*; isotypes, Delessert Herb., Bot. Gard. Genève, FM). — Exact locality lacking, *J. Dombey s.n.* (TYPE of *Freziera Dombeyana*, Paris; photo, FM). — Dept. Huánuco, Río Pozuzo, near Palcazu, alt. 1600–1700 m., *A. Weberbauer 6755* (FM, G, US).

This species is characterized by oblong-linear-lanceolate leaves, up to 15–17 cm. long and 3.0–3.5 cm. wide, coriaceous, glabrous above, golden brown, lanuginose and longitudinal striated below, margin serrulate, long acuminate at apex, tapering at base into a winged, involute petiole 1.5–2.0 cm. long. In the petioled leaves it resembles *F. chrysophylla*. However, the leaves are narrower and covered with a much darker pubescence. The flowers of *F. tomentosa* are large and sessile as in *F. sericea* and *F. longipes*. In the type of *Lettsomia tomentosa* the calyx-lobes are pubescent (sparsely so), while in *Weberbauer 6755* the calyx-lobes are nearly glabrous. *Freziera longipes* can be distinguished by the presence of heavy, wide leaves with a strong petiole. The principal characters separating *F. tomentosa* from *F. chrysophylla* and *F. candicans* are the sessile flowers and quite glabrous calyx-lobes. Also the flower parts are much larger in this species than those of the other two.

Belonging here also is *F. Dombeyana*. In the original description Tulasne drew attention to the very close relationship to *Lettsomia tomentosa* and mentioned that, perhaps, it was the same as the species described by Ruiz and Pavon.

30. **Freziera lanata** (Ruiz & Pavon) Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8**: 334. 1847, in obs. — Weberbauer in Engler & Drude, Veg. Erde, **12**: 263. 1911.

Lettsomia lanata Ruiz. & Pavon, Fl. Peruv. Chil. Prodr. **4**: 77. 1794; Syst. Veg. 135. 1798. — De Candolle, Prodr. **1**: 525. 1824.

Eurya lanata (R. & P.) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149. 1925.

Freziera yungasia Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8**: 333. 1847. — Syn. nov.

Eroteum yungasium (Tul.) Rusby in Mem. Torrey Bot. Club ser. 3, **3**: 9. 1893.

Eurya yungasia (Tul.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior, op. cit. ed. 2, **21**: 149. 1925.

Freziera boliviensis Wawra in Martius, Fl. Bras. **12**[1]: 284. 1886. — Syn. nov.

Eurya boliviensis (Wawra) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit., ed. 2, **21**: 149. 1925.

DISTRIBUTION: South America (Peru, Bolivia).

PERU: Exact locality lacking, *J. Pavon s.n.* (photo and fragment of type of *Lettsomia lanata,* FM). — Dept. Ayacucho, above Ayma between Tambo and the Apurimac river, alt. 1900 m., *A. Weberbauer 5610* (FM, G, US), June 1910 (shrub 4 m. with yellowish white flowers). — Dept. Ayacucho, Ccarrapa, between Huanta and Río Apurimac, wooded hillside, alt. 1000 m., *E. P. Killip & A. C. Smith 22458* (FM, NY, US), May 1929 (tree 3–4 m.). — Dept. Junín, San Ramón, dry woods, alt. 900–1300 m., *E. P. Killip & A. C. Smith 24773* (FM, NY, US), June 1929 (tree 3–4 m.). — Dept. Huánuco, Yanano, sunny hillside, alt. 1800 m., *J. F. Macbride 3765* (FM), May 1923 (compact shrub-tree, 4 m.). BOLIVIA: Yungas, *Pentland 178* (TYPE of *F. yungasia,* Paris, photo and fragment FM). — Yungas, *A. M. Bang 386* (FM, G, MO, NY, US), 1890. — Yungas, in woods, alt. 2100 m., *O. Buchtien 563* (US), Nov. 30, 1906. — Dept. La Paz, Larecaja, in woods, alt. 2800 m., *G. Mandon 830* (isotypes of *F. boliviensis,* FM, Genève, Gray, NY, Paris, Vienna), *831* (G, FM), June 1860. — Dept. La Paz, Prov. Larecaja, Copacabana, about 10 km. south of Mapiri, alt. 850–950 m., *B. A. Krukoff 10993* (AA, NY), Oct.–Nov. 1939 (tree 24 m.). — Mapiri region, alt. 850 m., *O. Buchtien 1680* (FM, NY, US), Feb. 1927. — Dept. La Paz, Tipuani, alt. 1400 m., *O. Buchtien 5462* (G, NY, US), *7379* (FM, MO, NY, US), 1920–1922. — Dept. La Paz, Apolo, alt. 1500 m., *R. S. Williams 1509* (NY, US), *2448* (US), 1901–1902 (6 m. tall). — Dept. Cochabamba, Prov. Chapare, in woods, alt. 2300 m., *J. Steinbach 8923* (AA, FM, G, NY), Jan. 23, 1929 (tree 5 m., flowers greenish white).

Young branchlets covered with a light buff, short tomentum, later becoming glabrescent. Leaves linear to oblong-ovate, coriaceous, 5–10 (–12) cm. long and 2–3(–4) cm. wide, acute at the apex, base equilateral, cuneate or subrotund, the upper surface opaque, glabrous, occasionally pubescent on basal portion of midrib, the lower surface covered with light colored, short tomentum with the 20 or more pairs of veins and cross-veins conspicuous even under tomentum; petiole 2–5 mm. long, pubescent. Flowers axillary, in close succession on short floral branchlets appearing as abbreviated racemes; pedicels very short, unequal, 2–3 mm. long, densely pubescent; calyx-lobes 5, imbricate, unequal, 1.5–2.0 mm. long, subrotund, densely tomentose; petals 5, imbricate, lightly connate at base, oblong-linear or ovate-oblong, un-

equal in width, 4–6 mm. long, 1.5–2.0 mm. wide; stamens not seen; ovary glabrous, ca. 1 mm. long, tapering into a thick style (1 mm. long) and topped by a 3-parted conspicuous (for the genus) stigma, 3-celled. Fruit globose, ca. 4–5 mm. diameter, crowned by persistent style and occasional stigma, many-seeded.

The short buff colored tomentum, through which the veins show clearly, is an outstanding character of the species. In a few specimens this character is almost lacking, found only on both sides of the midrib and where the leaf was folded in bud. The small flowers on the axillary floral branches furnish an unusual character. These short branchlets are bereft of any leaves and evidently bear flowers for more than one season. Some of the branchlets are over a centimeter in length and show, in close succession, the scars of former flowers.

After studying considerable material it is quite impossible to maintain *F. yungasia* as a species or even as a variety. Most of the Bolivian material labeled *F. yungasia* agrees with the typical Peruvian material of *F. lanata*. However, several collections present singular variations which, unfortunately, are not consistent throughout. It is on these variations that *F. yungasia* was originally based. *Buchtien 7379* is found in four herbaria. In FM, MO, and NY are specimens representing typical *F. lanata*. However, in US, and a second specimen in MO, are supposed duplicates with wider leaves, more coarsely serrate, and a pubescence less dense, longer and silky. *Bang 386* consists of seven specimens, six of which (FM, G, MO, NY, and US) are of the wider-leaved, silky pubescent type, while at NY is found a single specimen typical of *F. lanata*. *Weberbauer 5610* (FM, G, US) have typically lanate pubescent leaves while a fourth *5610* (FM) has leaves nearly glabrous. *Krukoff 10933* (AA, NY) is typically *F. lanata* but nearly glabrous in both specimens.

Perhaps, if one were examining all the material of *Buchtien 7379, Bang 386* or *Weberbauer 5610* separately, a conclusion that two species were included under a single number might be reached. However, it is quite baffling to find this same consistent variation carried through several collections.

Cited here also in synonymy is *Freziera boliviensis* Wawra. *Mandon 830,* collected in Bolivia, is the only representative of *F. boliviensis* in the material studied. This one specimen is merely smaller leaved than most representatives of this species. It agrees in leaf-shape, the distinctive pubescence, the unusual raceme-like floral branchlets and all the other characters mentioned above.

31. **Freziera roraimensis** Tulasne in Ann. Sci. Nat. sér. 3, **8**: 339. 1847.

Eurya roraimensis (Tul.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit., ed. 2, **21**: 149. 1925.

Freziera guianensis Wawra in Martius, Fl. Bras. **12**[1]: 284. 1886. — Syn. nov.

Eurya guianensis Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit., ed. 2, **21**: 149. 1925. — Syn. nov.

DISTRIBUTION: South America (Venezuela, Mt. Roraima).

VENEZUELA: Vicinity of Mt. Roraima, *R. Schomburgk 591* (leaf fragment of type of *F. roraimensis*, FM), *511* (leaf fragment, FM), 1842–1843.

The branchlets fulvous pubescent at first, later glabrous. The leaves coriaceous or subcoriaceous, oblong-lanceolate, 6–9 cm. long and 2–3 cm. wide, acute at the apex, equilateral and attenuate at the base into a pubescent slightly winged canaliculate petiole ca. 1 cm. long, glabrous, shining on upper surface, lightly sericeous pubescent below at first, later glabrous, the margin dentate, the veins ca. 9 pairs laxly arranged. According to Tulasne, the flowers are borne on a very brief axillary peduncle (2–4 mm. long), the pedicel 4–5 mm. long, tomentose, with the 2 bracteoles at the apex, just below the calyx, acute and tomentose; sepals 5, imbricate, broadly ovate or orbicular, tomentose, scarcely 2 mm. long; petals 5, ca. 6 mm. long, subacute; stamens 15–18, the anthers oblong, scarcely acute; ovary "linear-conic," glabrous, acute, 3-celled, indefinite number of ovules, the stigma 3-parted.

The above notes, with the exception of those concerning the leaf-characters, were compiled wholly from the original description. Tulasne feels that the species is closely related to *F. lanata*. Wawra's description of *F. guianensis* is very incomplete, still the close relationship to the present species is very evident. Both *F. roraimensis* and *F. guianensis* were collected at the same locality by the same collector. There is no doubt in my mind that only one good species exists in this locality and close relationship with any of the Andean species of western South America is very remote.

32. **Freziera canescens** Humboldt & Bonpland, Pl. Aequin. **1**: 25, t. 6. 1808. — Smith in Rees, Cyclop. **15**: no. 5. 1810. — De Candolle, Prodr. **1**: 525. 1824. — Sprengel, Syst. Veg. **2**: 596. 1825. — Spach, Hist. Nat. Vég. **4**: 64. 1835. — Triana & Planchon in Ann. Sci. Nat. Bot. sér. 4, **18**: 263. 1862.

Eurya canescens (H. & B.) Blume, Mus. Bot. Lugd.-Bat. **2**: 105. 1856. — Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Hieronymus in Bot. Jahrb. **20**, Beibl. **49**: 51. 1895.

DISTRIBUTION: South America (Colombia, Peru, Ecuador).

ECUADOR: Prov. Tungurahua, hacienda San Antonio, near Baños, *H. Sydow 559,* Dec. 17, 1937. — Prov. Pichincha, near Quito, *A. Bonpland s.n.* (TYPE, Paris; fragment, FM). COLOMBIA: Dept. El Cauca, Las Escaleretas, Moras Valley, Río Paez basin, Tierra Adentro, alt. 2500–3000 m., *H. Pittier 1338* (US), Feb. 1906 (medium-sized tree; flowers white, closed; fruit a black oval berry). — Dept. El Cauca, alt. 2200–3300 m., *F. C. Lehmann 3687* (US), *6445* (FM, G, US). — Dept. El Cauca, Mt. Puracé, thickets along Río Aguablanca, alt. 2900–3100 m., *E. P. Killip 6743* (G, NY, US), June 1922 (tree). — Dept. Nariño, Pasto, alt. 3000 m., *J. Triana s.n.* (NY), 1851–1857. — Without definite locality, *J. C. Mutis 695 (241)* (US). — Dept. El Cauca, Puracé, Cascade Chirimbolo, alt. 3200 m., *E. Dryander 1655* (US), Sept. 1936 (tree 3–4 m., common name *"Motilon"*). — Dept. El Cauca, vicinity of Puracé, alt. 2700–3100 m., *E. Pérez Arbeláez and J. Cuatrecasas 5975* (US), July 11, 1939 (tree). PERU: Dept. Huanuco, Pan de Azucar, *M. Sawada 67* (FM), July 2, 1927 (35 ft. high).

Freziera canescens is a medium-sized tree (5–6 m.). The brownish, terete young branchlets are covered, at first, with a white tomentum (later becoming glabrescent) and are sparsely dotted with white-yellow lenticels. Leaves strongly coriaceous, up to 15 cm. long and 6 cm. wide, ovate-elliptic, obtuse to bluntly acute at the apex, cuneate at the base, glabrous and shining above, densely blonde tomentose below, the veins many, slightly elevated above, the midrib canaliculate above, the margin revolute at base of leaf, otherwise lightly serrate, the petiole ca. 1 cm. long, sulcate. The flowers large, fasciculate, 1–4 in axils of leaves; pedicels tomentose, thick, varying in length up to 6 mm. long, ca. 2 mm. diam.; bracteoles 2, immediately beneath calyx, sepaloid, deltoid, pergamentaceous, ca. 7 mm. long, 8–9 mm. wide, tomentose, apiculate; sepals 5, imbricate, concave, tomentose in center, glabrous at margin, ciliolate, pergamentaceous, ovate to deltoid, unequal, 6–7 mm. long, 7–9 mm. wide; petals 5, texture similar to sepals at base, inner ones more nearly membranaceous, ovate, white, glabrous, 11–12 mm. long, 6.0–8.5 mm. wide; stamens 20–25, uniseriate, glabrous, the filaments ca. 1 mm. long, 0.5 mm. wide at center, attenuated at both ends, the anthers linear, 4.5 mm. long, nearly 1 mm. wide, opening by longitudinal slits, the ovary (♂ fl.) glabrous, ca. 6 mm. long, 3 mm. diam., tapering quickly for 2 mm. into a blunt style (the customary 3-parted stigma seems to

be absent even in fruiting specimens), tri-locular, multi-ovulate. Fruit ovoid, 8–10 cm. long and broad, 3-celled. Seeds many (over 100) minute, typical of the genus, 1 mm. or less long.

The above description seems quite essential, considering no record of measurements has ever been made. Humboldt and Bonpland refer to the 4-parted stigma and 4-celled ovary and fruit. The material examined by the present author exhibited only 3-celled ovaries and fruit.

The large flowers, seemingly woody, sometimes four to the axil, covered with a dense white tomentum, the large, quickly tapering fruit, the very brief style and the white tomentose coriaceous broadly ovate leaves distinguish this species from its relatives. The fruits grow to such proportions that the persistent calyx-lobes tend to split, giving a very ragged appearance to the fruit clusters.

The specimens *Mutis 695*, *Dryander 1655*, and *Pérez Arbeláez* and *Cuatrecasas 5975*, cited above, vary from the type in having smaller leaves (not over 9 cm. long and 3 cm. wide) and the stem decidedly geniculate. Otherwise, they agree with the description.

32A. **Freziera canescens** Humboldt & Bonpland forma **rufescens**, forma nova.

A typo differt ramulis foliisque pubescentibus rufescentibus.

DISTRIBUTION: South America (Ecuador).

ECUADOR: In the Ecuadorian Andes, *R. Spruce 5089* (TYPE, G; isotypes, FM, NY), 1857–1859.

This form is separated from the species on the dense colorful pubescence on the under surface of the leaves. Otherwise, it agrees well with the species.

33. **Freziera candicans** Tulasne in Ann. Sci. Nat. Bot. sér. 3, **8**: 328. 1847.

Lettsomia candicans (Tul.) Choisy in Mém. Soc. Phys. Genève, **14**: 125. 1855.

Eurya candicans (Tul.) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190. 1893. — Melchior in Engler & Prantl, op. cit., ed. 2, **21**: 149. 1925.

Eurya Seemanniana Pittier in Contrib. U. S. Nat. Herb. **20**: 480. 1922. — Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149. 1925. — Standley in Field Mus. Nat. Hist. Bot. ser. **18**: 701. 1937.

Freziera Seemanniana (Pittier) Kobuski in Ann. Missouri Bot. Gard. **25**: 355. 1938.

Freziera sericea Hemsley, Biol. Centr.-Amer. **1**: 93. 1879. — Non Humboldt & Bonpland (1808).

DISTRIBUTION: Central America (Costa Rica, Panama); South America (Venezuela, Colombia).

PANAMA: Chiriquí, forests around El Boquete, alt. 1000–1300 m., *H. Pittier 2944* (TYPE of *F. Seemanniana*, US; isotypes, FM, G), March 1911 (middle-sized tree; "sajinillo").—Same locality, alt. 1800 m., *M. E. Davidson 562* (AA, FM), April 11, 1938 (tree 6–15 m. with pale yellow flowers).—Volcan de Chiriquí, vicinity of Casita Alta, alt. 1500–2000 m., *R. E. Woodson, P. H. Allen and R. J. Seibert 904* (AA, FM, MO), June 1938 (tree 5 m. with yellowish white flowers). COSTA RICA: region of Zarcero, alt. 1700–1800 m., *Austin Smith 153* (FM, MO), *H 224* (FM, MO), *A 408* (FM, MO, NY), Aug. 1937–Jan. 1938.—La Palma de San Roman, alt. 1100 m., *A. M. Brenes 4482, 5505* (FM).—Vara Blanca de Sarapiqui, north slope of Central Cordillera, between Poás and Barba Volcanoes, alt. 1950 m., *A. F. Skutch 3479* (AA, NY), Jan. 1938 (tree 8 m. with white flowers).—Alajuela Prov., Volcan de Poás, moist forest, alt. 2100–2600 m., *P. C. Standley 34641* (FM, US), Feb. 1924 (tree 6 m.).—San José Prov., moist forest, alt. 1500–1800 m., *P. C. Standley 32629, 42534* (FM, NY, US), *42940* (US), Mar. 1924–Dec. 1925 (tree 6–15 m. with smooth, pale brown bark, white flowers and black fruit).—Prov. Cartago, brushy slope, *P. C. Standley 39280* (US), Mar. 1924 (shrub 3.0–4.5 m.; fruit black). VENEZUELA: State of Aragua, near Colonia Tovar, *A. Fendler 52* (G), 1854–1855.—Distr. Federal, Caracas, *A. Bonpland s.n.*, (photo of TYPE, FM).—Camino de la Silla de Caracas, alt. 2100 m., *E. Delgado 230* (US), Apr. 5, 1939.—La Cienega, Silla de Caracas, alt. 2000–2600 m., *H. Pittier 8361* (G), Dec. 1918 (small tree, 6 m.).—Without exact locality, *H. Karsten s.n.* (FM). COLOMBIA: Dept. El Cauca, Popayán, Timbio en Hatovieja, alt. 1800 m., *E. Pérez Arbeláez* and *J. Cuatrecasas 6088* (US), July 14, 1939.

Tree medium sized; young branchlets densely hairy at first, later smooth. Leaves petiolate, subcoriaceous; petioles hairy, winged, canaliculate, ca. 1.0–1.5 cm. long; blades ovate-lanceolate or ovate-oblong, 7–15 cm. long, 3–5 cm. wide, acuminate at apex, cuneate at base, glabrous above, silky pubescent beneath, the margin usually serrulate, occasionally subentire. Flowers axillary, fasciculate (3–7), pedicellate, the pedicels 3–8 mm. long, hairy; bracteoles suborbicular, ca. 2–3 mm. long, sepaloid, densely pubescent; calyx-lobes 5, orbicular, imbricate, densely pubescent on outer surface (at least, the outer ones), 3–4 mm. long and broad; petals ovate, white, yellowish white or pale yellow, 6–8 mm. long, glabrous, lightly connate at base; stamens 20–25, uniseriate, adnate to the base of the petals, 2.0–2.5 mm. long; ovary

ovoid, tapering into the short style, topped by 3–5-parted stigma. Fruit globose, black, glabrous, 7–9 mm. diam., 3–4–5-celled, many-seeded.

This species, long overlooked by botanists, has an extensive range (Venezuela to Costa Rica) and has been misinterpreted as belonging to *F. sericea, F. chrysophylla,* and later to *F. Seemanniana.*

There is considerable variation in the species, but no more than is found in all other species of this genus. The Panamanian material is characterized by entire or nearly entire leaves, while at all other localities the material has serrulate leaves. This is one of the characters used by Pittier in separating the species from *F. sericea.* However, in the type of *F. Seemanniana* (*Pittier 2944*), evidences of serrulation can be seen on the leaf-margins. *Woodson, Allen & Seibert 904* from the type locality has the more nearly entire-margins. However, in this specimen, the margin is somewhat revolute. In *Davidson 562,* also from the type locality, the leaf-margins are slightly serrulate. The Costa Rican material agrees more closely with that of South America. In both *Standley 32636* (Costa Rica) and *Delgado 230* (Venezuela) are found, on the same specimen, fruits with 3, 4 and 5 loculi. *Karsten s.n.* (Venezuela) has fruit that is 4-celled while in *Skutch 3479* (Costa Rica), the fruit is 3-celled. Variation in density and color of pubescence is found. Usually the pubescence is white or yellowish. The variation in color is more particularly noticeable in the unfolding leaves.

Pittier intimates that his *Eurya Seemanniana* is close to *F. sericea.* However, it is more nearly related to *F. chrysophylla* from which it is separated by the longer pedicelled flowers, globose fruit, less dense pubescence, and the pronounced veining on the upper surfaces of the leaves.

34. **Freziera chrysophylla** Humboldt & Bonpland, Pl. Aequin. **1:** 27, t. 7. 1808. — Smith in Rees, Cyclop. **15:** no. 6, 1810. — De Candolle, Prodr. **1:** 525. 1824. — Sprengel, Syst. Veg. **2:** 596. 1825. — Spach, Hist. Nat. Vég. **4:** 64. 1835.

Freziera sericea H. & B. var. *chrysophylla* (H. & B.) Triana & Planchon in Ann. Sci. Nat. Bot. sér. 4, **18:** 263. 1862. — Wawra in Martius, Fl. Bras. **12**[1]**:** 283. 1886.

Eurya sericea (H. & B.) Blume var. *chrysophylla* (H. & B.) Hieronymus in Bot. Jahrb. **20,** Beibl. **49:** 49. 1895.

DISTRIBUTION: South America (Colombia).

COLOMBIA: Dept. El Cauca, near Popayán, *A. Bonpland s.n.* (TYPE, Herb. Mus. Paris; fragment FM). — Cauca Valley, Río Piendamo, alt. 1700–1900 m., *F. W. Pennell & E. P. Killip 6386* (G, NY, US), June 6, 1922 (shrub in thicket growth). — Dept. El Cauca, Puracé, bushy

slopes, alt. 1900–2100 m., *Pennell & Killip 6403* (G, NY, US), June 1922 (tree with orange flowers). — Dept. El Cauca, Popayán, *F. C. Lehmann 4450* (FM, G, US). — Dept. El Cauca, Popayán, *H. Karsten s.n.* (FM, Vienna) (fruit fleshy, edible). — Dept. Antioquia, between Carolina and Santa Rosa, alt. 2000–2500 m., *F. C. Lehmann CCXIX* (US), Sept. 1884. — Dept. Antioquia, Sonson, *R. A. Toro 1230* (NY), July 20, 1928. — Dept. Antioquia, La Ceja, *Bro. Daniel 401* (US), July 1934 ("cerezo de monte"). — Dept. Antioquia, Cerro de la Vieja, alt. 2650 m., *Bro. Daniel 1708* (US), Dec. 1938. — Dept. Cundinamarca, Tenasuca, near Bogotá, alt. 1800 m., *J. Triana s.n.* (NY).

This species is characterized by lanceolate, petiolate, coriaceous leaves, glabrous above, sericeous below, acuminate at the apex, cuneate at the base, tapering into a winged, canaliculate petiole. The flowers are very short-pedicelled, quite small, with sericeous pedicels, bracteoles and calyx-lobes. The ovary is usually three-celled (four-celled, fide Humboldt and Bonpland) and the stigma three-lobed.

Triana and Planchon reduced this species to a variety of *F. sericea.* The pubescence and longitudinal striations on the under surface of the leaves indicate this relationship. However, *F. sericea* has larger, sessile flowers in which the calyx-lobes are glabrous and the ovary five-celled. The leaves are sessile or subsessile and not as pronouncedly acuminate.

More closely related is *F. candicans.* This last species ranges up into Costa Rica and has leaves which, though petioled and acuminate, are smaller, more ovate than lanceolate with pronounced, more strict veins on the upper surface and a much less dense and shorter pubescence on the under surface. The leaf-margin is entire, subentire or lightly serrulate. The flowers are definitely pedicellate, hence less crowded in the axils than those of *F. chrysophylla.*

DOUBTFUL SPECIES

Freziera Bonplandiana Tulasne in Ann. Sci. Nat. Bot. sér. 3, 8: 335. 1847.

Distribution: South America (Colombia?).

Colombia: *A. Bonpland s.n.* (photo and leaf fragment of type, FM).

The leaf is coriaceous, shining and glabrous above, appressed puberulent below. The veins are distinct, and close together. The leaf-base is obtuse and tapers into a winged, canaliculate petiole. The calyx-lobes are glabrous. According to Tulasne, there are ca. 25 stamens and the ovary is 3-celled. This species is most closely related to *F. nervosa,* which has a rounded leaf-base. The veins are lax and open,

compared with those of *F. Bonplandiana*. The calyx-lobes are pubescent and the stamen number is ten.

This species seems to have been collected only once (probably in Colombia), reported as a new species by Tulasne and then never mentioned again. The specific status must remain in question, perhaps, even after examining the type. The flowers appear (from photo) to be in the bud.

Freziera conocarpa (O. Schmidt) Kobuski in Ann. Missouri Bot. Gard. **25**: 354. 1938.

Eurya conocarpa O. Schmidt in Fedde, Rep. Spec. Nov. **22**: 98. 1925.

No material of this species is available for the present study. In the original description, Schmidt refers to the branchlets as opposite, alternate, or subverticillate, with the leaves at the apex of the branchlets. These characteristics plus a two-celled ovary with 4 ovules to each cell leads one to believe that the species probably belongs to *Ternstroemia* rather than *Freziera* as Schmidt suggests in his observations.

Freziera monzonensis (Melchior) Kobuski in Ann. Missouri Bot. Gard. **25**: 355. 1938.

Eurya monzonensis Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. *2*, **21**: 149. 1938.

DISTRIBUTION: South America (Peru).

PERU: Precise locality lacking, *A. Weberbauer 3422* (photo of type, AA, FM, G).

Melchior merely recorded this species in his treatment of the Theaceae (l.c.), intending, probably, to follow up later with a technical description. This, however, he neglected to do. From a photograph of the type, this species may be characterized by coriaceous, oblong-obovate leaves, 9–14 cm. long and 4–5 cm. wide, broadly acuminate at the apex, rounded or obtuse at the base, pubescent above where young, densely sericeous below, the margin slightly serrulate or subentire, the petiole 3.0–3.5 cm. long, winged, involute. Flowers 1–3, fasciculate, axillary, seemingly sessile and densely sericeous (buds only).

Very closely related is *F. reticulata* var. *subintegrifolia* (Hieron.) Kobuski. However, *F. monzonensis* varies from this variety in the acuminate apex of the leaf and in the type of pubescence (sericeous) on the under surface of the leaf. Because of the longer silky sericeous pubescence the veining on the under surface is obscured. Otherwise these two seem to agree very well.

HERBARIUM, ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

STUDIES OF PAPUASIAN PLANTS, IV*

A. C. Smith

This paper discusses new and otherwise noteworthy species in the families Dilleniaceae, Actinidiaceae, and Ochnaceae. Specimens are cited from the herbaria of the Arnold Arboretum (A), New York Botanical Garden (NY), and Yale School of Forestry (Y); for specimens seen only in the herbarium of the Arnold Arboretum no place of deposit is indicated.

DILLENIACEAE

Hibbertia Andr.

Hibbertia Banksii (R. Br.) Benth. Fl. Austral. **1**: 20. 1863; Bailey, Queensl. Fl. **1**: 12. 1899.

Hemistemma Banksii R. Br. ex DC. Reg. Syst. Veg. **1**: 414. 1817.

British New Guinea: Western Division, Tumbuke, Wassi Kussa River, *Brass 8431* (shrub 1–2 m. high, common in *Agonis* scrubs; leaves stiff, convex, brown-pubescent beneath; flowers yellow).

This is the second species of *Hibbertia* reported from New Guinea; it belongs in the Section *Hemistemma,* whereas *H. novo-guineensis* Gibbs, a montane species from the Arfak region, belongs in the Section *Cyclandra,* Group *Subsessiles.* The Brass specimen agrees precisely with Australian material of *H. Banksii;* some of its branchlets bear unusually large leaves, with blades up to 13 cm. long and 3 cm. broad.

Wormia Rottb.

Diels (in Bot. Jahrb. **57**: 436–439. 1922) referred the Papuan species of this alliance to *Dillenia,* but other recent students, including Gilg and Werdermann (in Engl. & Prantl, Nat. Pfl. ed. 2. **21**: 33–36. 1925) and Corner (in Gard. Bull. Straits Settlem. **10**: 3. 1939) separate *Wormia* and *Dillenia.* In view of the substantial differences in fruit between the two groups, this separation seems amply warranted; all of the Papuasian species appear to belong to *Wormia.*

*(Botanical Results of the Richard Archbold Expeditions) See Jour. Arnold Arb. **22**: 60–80. 1941; op. cit. 231–252; op. cit. 343–374.

Wormia (§ *Euwormia*) **macrophylla** (Lauterb.) Gilg & Werderm. in Engl. & Prantl, Nat. Pfl. ed. 2. **21**: 35. 1925.

Dillenia alata var. *macrophylla* Lauterb. in Bot. Jahrb. **45**: 362. 1911; Lane-Poole, Rep. For. Res. Papua 116. 1925.
Dillenia macrophylla Diels in Bot. Jahrb. **57**: 437. 1922.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, alt. 50 m., *Brass 14114* (canopy tree, attaining a height of about 25 m., very abundant and often gregarious in flooded rain-forests of river-plain; trunk up to 80 cm. in diameter, usually hollow; bark flaky, pale reddish brown; petals yellow; anthers red).

The species has previously been reported from Neu-Mecklenburg and from the Ramu River in Northeastern New Guinea; according to Lane-Poole it is abundant in the latter locality.

Wormia (§ *Euwormia*) **crenata** sp. nov.

Arbor grandis ubique praeter inflorescentiam et petiolorum alas interdum sparse pallide puberulas glabra, ramulis fistulosis subteretibus vel apicem versus leviter complanatis siccitate rugosis cicatricosis; petiolis 4–6.5 cm. longis initio utrinque ala papyracea circiter 8 mm. lata superne auriculato-dilatata mox decidua ornatis, demum canaliculatis et longitudinaliter bicicatricosis; laminis subcoriaceis late ovato-ellipticis, 13–22 cm. longis, 10–18 cm. latis, basi truncatis vel obtusis, apice rotundatis vel inconspicue cuspidatis, margine grosse calloso-crenatis (dentibus 1–2.5 cm. distantibus), siccitate supra viridibus subtus fuscioribus, costa supra paullo elevata subtus prominente saepe carinata, nervis secundariis utrinsecus 8–14 rectis erecto-patentibus in dentibus exeuntibus utrinque manifeste elevatis, nervis tertiariis transversis numerosissimis rete venularum utrinque prominulo conjunctis; inflorescentiis in extremitate ramulorum oppositifoliis floribus inclusis 5–8 cm. longis 2- vel 3-floris, pedunculo et rhachi gracilibus juventute dense aureo-sericeis glabrescentibus, pedicellis sub anthesi circiter 1 cm. longis ut rhachi decidue sericeis; sepalis 5 subcoriaceis subaequalibus obovato-oblongis, 22–30 mm. longis, 18–24 mm. latis, apice rotundatis, margine subscariosis ciliatis et saepe inflexis, exterioribus extus dense et arcte aureo-velutinis, interioribus extus cinereo-sericeis; petalis desideratis; staminibus numerosis subaequalibus 11–13 mm. longis, filamentis castaneis ligulatis 6–8 mm. longis, antheris oblongis 5–7 mm. longis apice minute apiculatis poris subterminalibus dehiscentibus; carpellis circiter 7 glabris oblongis demum ad 15 mm. longis, stylis subulato-filiformibus circiter 15 mm. longis.

SOLOMON ISLANDS: Ysabel: Kakatio, alt. 900 m., *Brass 3242*

(handsome spreading tree, fairly common in rain-forests; bark thick, brittle, brown; wood yellowish; leaves very stiff, pale beneath; outer sepals orange; petals cream colored, falling without expanding; common name: *kepe*); Tatamba, alt. 50 m., *Brass 3418* (TYPE), Jan. 4, 1933 (very large straight-boled flanged tree, common in hardwood forests; bark pale brown, falling in soft scales; wood hard, brown; leaves very stiff; three outer sepals golden-yellow, the two inner ones pale green; petals white, falling without opening). Ulawa: alt. 250 m., *Brass 2957* (gregarious large tree, common in mountain rain-forests; branches widely spreading; bark reddish brown, exfoliating in very thin flakes; leaves stiff, shining above, pale beneath; sepals red; petals yellow, falling without opening; lower part of trunk often giving rise to numerous erect coppice shoots).

Wormia crenata is a relative of *W. macrophylla* (Lauterb.) Gilg & Werderm., from which it differs in its smaller and fewer-nerved leaf-blades with more conspicuously crenate margins, its fewer and smaller flowers, and its velutinous or sericeous rather than glabrous sepals.

Wormia (§ *Euwormia*) **nitida** sp. nov.

Arbor grandis, ramulis glabris subteretibus stramineis vel fuscis cicatricosis; petiolis 4–6.5 cm. longis initio utrinque ala subcoriacea stramineo-sericea 4–5 mm. lata mox decidua ornatis; laminis subcoriaceis late ovatis, 11–20 cm. longis, 7–15 cm. latis, basi subcordatis, apice rotundatis, margine conspicue undulato-crenatis, supra nitidis glabris, subtus costa et nervis interdum inconspicue adpresso-sericeis et in angulis nervorum barbatis, costa supra paullo elevata et interdum inconspicue sulcata subtus prominente et carinata, nervis secundariis utrinsecus 11–16 rectis patentibus marginem versus curvatis et indistincte anastomosantibus supra subplanis vel impressis subtus elevatis, nervis tertiariis transversis numerosis et rete venularum utrinque prominulis vel subplanis; inflorescentiis sub anthesi ubique glabris apicem ramulorum versus oppositifoliis floribus inclusis 4–6 cm. longis 2–4-floris, pedunculo et rhachi crassis leviter angulatis, pedicellis sub anthesi 15–18 mm. longis; sepalis 5 subcoriaceis late ovatis vel suborbicularibus, apice rotundatis vel obtusis, exterioribus ad 33 mm. interioribus ad 25 mm. diametro; petalis desideratis; staminibus circiter 60 subaequalibus 15–18 mm. longis, filamentis ligulatis submembranaceis basim versus circiter 0.8 mm. latis, antheris lineari-oblongis acutis 7–8 mm. longis; carpellis 9–11 glabris sub anthesi rugosis et circiter 15 mm. longis sub fructu ad 25 mm. longis et 7–8 mm. latis, stylis filiformibus circiter 10 mm. longis.

BRITISH NEW GUINEA: Central Division, Mafulu, alt. 1400 m., *Brass 5282* (A, TYPE, NY), Oct. 16, 1933 (large tree, plentiful in limestone forests, the trunk with heavy, rounded, short, spur buttresses; bark bright reddish brown, flaky; wood reddish brown, hard, heavy; leaves glossy, the nerves pale, impressed above, prominent beneath; outer sepals red, the inner ones yellow-green; common name [Kuni language]: *manava;* wood durable and used in building).

Wormia nitida is closely related only to *W. quercifolia* White & Francis, from which it differs in having its leaf-blades subcordate rather than obtuse at base, its secondary nerves more numerous and with barbellate tufts of hairs in their axils, its inflorescence more robust, and its flowers nearly twice as large in all parts.

Wormia (§ *Euwormia*) **insignis** sp. nov.

Arbor ad 30 m. alta ubique praeter inflorescentiam glabra, ramulis subteretibus fuscis oblique cicatricosis; petiolis 4–6.5 cm. longis utrinque ala subcoriacea ad 8 mm. lata inferne gradatim attenuata superne ad laminam abrupte rotundata vel inconspicue auriculata persistenter ornatis; laminis subcoriaceis siccitate fuscis ellipticis, 8–11 cm. longis, 5–8 cm. latis, basi rotundatis vel obtusis et interdum alis petiolorum confluentibus, apice obtusis vel inconspicue cuspidatis, margine integris, costa supra inconspicue elevata subtus prominente et carinata, nervis secundariis utrinsecus 6–8 rectis erecto-patentibus marginem versus arcuatis et inconspicue anastomosantibus supra subplanis subtus acute elevatis, rete venularum supra immerso subtus leviter prominulo vel plano; racemis brevibus subterminalibus saepe 2-floris, pedunculo, rhachi, et pedicellis 35–45 mm. longis validis debiliter cinereo-pilosis; sepalis 5 subcoriaceis, suborbicularibus vel elliptico-oblongis, apice rotundatis, margine scariosis et saepe leviter ciliatis, extus sericeo-puberulis glabrescentibus, exterioribus 18–23 mm. interioribus 25–27 mm. diametro; petalis 5 papyraceis vel submembranaceis subcucullatis obovato-oblongis, 30–35 mm. longis, 20–30 mm. latis, apice rotundatis, basim versus angustatis, inconspicue nervatis, mox caducis; staminibus numerosissimis circiter 3-seriatis subaequalibus 23–28 mm. longis, filamentis castaneis submembranaceis ligulatis 14–20 mm. longis, basim versus 1–1.5 mm. latis, superne gradatim angustatis, antheris linearioblongis 7–9 mm. longis, apice minute apiculatis poris subterminalibus dehiscentibus; carpellis circiter 9 oblongis sub anthesi 10–12 mm. longis dense cinereo-sericeis (pilis 0.5–1 mm. longis); stylis subulato-filiformibus 12–15 mm. longis, basi in columnam crassam circiter 4 mm. longam et 3 mm. diametro sericeam connatis, superne glabris et recurvatis.

SOLOMON ISLANDS: Bougainville: Kupei Gold Field, alt. 1000 m., *Kajewski 1740* (TYPE), April 18, 1930 (large tree to 30 m. high, common in rain-forest; pedicels pink, covered with light fine hairs; petals apricot to dark pink, very showy; stamens light brown, paler distally; styles light green).

This remarkably distinct species is characterized by its comparatively small and few-nerved leaf-blades, long petioles with conspicuously broad and persistent wings, few flowers, sericeous sepals, extremely long filaments, sericeous carpels, and basally connate styles. Probably most closely related to *W. macrophylla* (Lauterb.) Gilg & Werderm. and its allies, the new species is readily distinguished by the above-mentioned characters.

Wormia (§*Euwormia*) **ingens** (Burtt) comb. nov.

Dillenia ingens Burtt in Kew Bull. **1935**: 299. 1935.

SOLOMON ISLANDS: Bougainville: Kugumaru, Buin, alt. 150 m., *Kajewski 1973* (large tree up to 20 m. high, common in rain-forest; leaf-blades up to 75 cm. long and 40 cm. broad; fruiting pedicels pink; common name: *aukaba;* fruits and leaves eaten by opossums). Ysabel: Garona River, *Brass 3353* (few-branched tree up to 20 m. high, common in swampy lowland rain-forests; bark brown, uneven; wood brown, with numerous very distinct rays; leaves clustered towards ends of branches, the blades up to 1 m. long and 50 cm. broad or more, with a broad pale stripe along center of costa on upper surface, the secondary nerves very pale; fruiting sepals red).

The type collection of this striking tree was obtained on Bougainville, and a second collection was mentioned by Burtt as from New Georgia. Our material differs from the original description only in its even larger leaves, its stipules to 11 cm. in diameter, and its sepals to 5 cm. long. *Waterhouse 25* (Y, type coll.) also has larger stipules than those mentioned by Burtt.

Wormia (§ *Capellia*) **auriculata** (Martelli) Gilg & Werderm. in Engl. & Prantl, Nat. Pfl. ed. 2. **21**: 35. 1925.

Dillenia auriculata Martelli in Becc. Malesia **3**: 159. 1886.

BRITISH NEW GUINEA: Western Division, Fly River, 528-mile Camp, alt. 80 m., *Brass 6821* (tall tree, in canopy layer of ridge-forests; leaves glossy, glabrous; flowers showy, about 10 cm. in diameter, the petals and stamens yellow, the carpels red); Palmer River, 2 miles below junction with Black River, alt. 100 m., *Brass 7275* (slender tree 30 m. tall, in ridge-forest canopy layer; trunk supported on prop-roots

about 1 m. long; bark reddish brown, flaky; wood, hard, brown; leaves stiff, glabrous, smooth, shining; flowers yellow, 11 cm. in diameter).

Wormia auriculata has previously been reported only from the type collection from northwestern Netherlands New Guinea. The species is known to me only from the original description, which appears to agree precisely with the Brass specimens in all essential details. The present collections have leaves with deciduous barbellate tufts of hair in the axils of secondary nerves beneath, and the carpels are usually 7 (rather than 10 as reported by Martelli).

ACTINIDIACEAE

SAURAUIA Willd.

Burtt (in Hook. Ic. Pl. **34**: *pl. 3316.* 1936) has remarked that the series proposed for the Papuasian species of *Saurauia* by Diels (in Bot. Jahrb. **57**: 441. 1922) and subsequently adopted by Gilg and Werdermann (in Engl. & Prantl, Nat. Pfl. ed. 2. **21**: 44. 1925) are largely artificial. It is true that such characters as the position and branching of the inflorescence, the degree of development of enveloping bracts, the pubescence of the lower surfaces of leaf-blades, and several others used by Diels to distinguish his series do not seem fundamental. As Burtt suggests, the type of indument may give a more dependable indication of the true relationships of the species. But, until some careful monographer has worked upon the genus in its entire range and has learned to distinguish between the fundamental and inconsequential characters, it seems advisable to follow the only system thus far proposed for the Old World species. The species of *Saurauia* are not difficult to recognize when adequate material is available, but characters which are fairly stable (i.e. type, direction, and length of hairs, shape of scales, size of flowers, number and arrangement of stamens, stylar arrangement, etc.) have not always been adequately described. In the following discussion of new and otherwise noteworthy species, the arrangement of Gilg and Werdermann is followed.

Many species of *Saurauia* have abundant and obvious fusiform crystal-bearing cells; the presence of these will perhaps be usable as a differentiating specific character, but up to the present they have scarcely been mentioned in formal descriptions. These cells contain both raphides and styloids and are most obvious in the leaves, petals, and ovaries of certain species.

From the material thus far available, it seems that only a few Papuasian species of *Saurauia* are to be considered abundant. Among

these are *S. conferta* Warb. (throughout New Guinea and in the Solomons), *S. Dufaurii* (F. v. Muell.) Diels (in British New Guinea), and *S. Schumanniana* (in Northeastern New Guinea and the Solomons). These species occur in rain-forests at comparatively low altitudes, rarely as high as 1200 m. Most Papuasian species of the genus, and especially those occurring at high elevations, appear to have very restricted ranges.

Saurauia calyptrata Lauterb. in Nova Guinea Bot. **8**: 838. 1912; Diels in Bot. Jahrb. **57**: 446. 1922.

Saurauia eximia Ridley in Trans. Linn. Soc. II. Bot. **9**: 14. *pl. 1, fig. 15–19.* 1916.

Netherlands New Guinea: 9 km. northeast of Lake Habbema, alt. 2600 m., *Brass 10908* (tree 3 m. high, on open bank of stream in forest; flowers white).

A careful comparison of the original descriptions of *S. calyptrata* and *S. eximia* indicates that only one species is concerned. It appears that Ridley misinterpreted the calyptrate bracteoles as "outer sepals" (*fig. 16*); these bracteoles are clearly present and completely enclose the young flowers on the present specimen. *Brass 10908* differs from the original descriptions in having its leaf-blades sometimes up to 7 cm. long and 3.5 cm. broad, its secondary nerves occasionally 8 in number, its pedicels to 3.5 cm. long, its flowers slightly smaller, and its stamens about 40 in number; these differences seem of no more than individual consequence. The leaf-blade and the ovary-wall of the Brass specimen have very obvious and abundant fusiform crystal-bearing cells.

Saurauia excurrens sp. nov.

Arbor 8–10 m. alta, ramis elongatis dependulis excurrentibus, ramulis gracilibus purpurascentibus apicem versus leviter angulatis et squamulas parvas deltoideas obtusas sparsas gerentibus demum subteretibus et glabris; petiolis gracilibus 7–22 mm. longis canaliculatis ut ramulis decidue squamulosis; laminis chartaceis anguste lanceolato-oblongis, 10–22 cm. longis, 1.5–3.5 cm. latis, basi acutis vel attenuatis, apice gradatim acuminatis, margine inconspicue crenato-serratis (dentibus 4–6 per centimetrum minute callosis) vel subintegris, supra siccitate fuscis et glabris, subtus pallidioribus et sparsim squamulosis mox glabris, costa supra valde impressa subtus prominente, nervis lateralibus utrinsecus circiter 50 cum aliis debilioribus interspersis patentibus nervo submarginali conjunctis supra subplanis subtus prominulis, rete venularum inconspicuo vel subtus paullo prominulo; inflorescentiis fasciculatis plerumque 4–10-floris axillaribus vel e ramulis defoliatis orientibus, bracteis ut videtur nullis vel mox caducis, pedicellis gracilibus 8–11 mm.

longis inconspicue squamulosis basim versus bracteolis 2 oblongis acutis 1.5–2 mm. longis squamulosis ornatis; floribus sub anthesi 10–13 mm. diametro ubique glabris; sepalis 5 papyraceis orbiculari-oblongis rotundatis valde inaequalibus, 2 exterioribus 2–2.5 mm. longis 1.5–2 mm. latis, 3 interioribus 3–4 mm. longis et latis; petalis 5 vel 6 sub anthesi patentibus membranaceis oblongis, circiter 7 mm. longis, 3–5 mm. latis, apice rotundatis vel leviter emarginatis; staminibus 30–40 plerumque 2-seriatis 2–3 mm. longis, filamentis membranaceis ligulatis basim versus connatis, antheris oblongis 1–1.2 mm. longis obtusis basim versus dorsifixis; ovario subgloboso 1.5–2 mm. diametro, stylis 3 inferne in columnam gracilem connatis 3–3.5 mm. longis in triente superiore liberis, loculis 3.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13265* (TYPE), March 1939 (tree 8–10 m. high, common in open seral growths on flood-plains in rainforest; branches long, drooping, excurrent and grouped at intervals; flowers white).

Saurauia excurrens is a very distinct species, characterized by its narrow and multinerved leaf-blades, its compact inflorescence usually best developed on the older parts of branchlets, its glabrous flowers, unequal sepals, comparatively few stamens, and three styles. In the system of Diels, it should be placed in the Series *Ramiflorae,* but its relationship to the only Papuan species of this series, *S. Rodatzii* Lauterb. & K. Schum., is remote. A better place for the new species is probably the Series *Squamulosae;* the above mentioned characters amply distinguish it from its allies, of which *S. desquamulata* Diels is perhaps the closest.

Saurauia rubrisquamata sp. nov.

Arbor gracilis 3–5 m. alta, ramulis gracilibus fistulosis subteretibus mox glabris; squamulis ramulorum juvenilium, petiolorum, inflorescentiae ramulorum, et calycis rubris carnosis (ex Brass) elongato-deltoideis acutis (1–)2–4 mm. longis; petiolis 10–18 mm. longis; laminis chartaceis obovatis, 8–15 cm. longis, 4–7 cm. latis, basi late cuneatis vel obtusis, apice cuspidatis vel breviter acuminatis, margine conspicue calloso-mucronulatis (setis crassis paullo curvatis 1–2 mm. longis), utrinque hinc inde praecipue in costa nervisque squamulosis, subtus pallidioribus, costa supra paullo elevata subtus prominente, nervis lateralibus utrinsecus 5–9 arcuato-adscendentibus supra prominulis subtus elevatis, venulis supra paucis prominulis; inflorescentiis axillaribus cymosis plerumque 3–5-floris, pedunculo gracili 3–6 cm. longo sparsim squamuloso, bracteis papyraceis obovato-oblongis cuspidatis

ad 15 mm. longis utrinque squamulosis, pedicellis gracilibus 10–22 mm. longis medium versus vel supra bracteolis 2 linearibus circiter 4 mm. longis ornatis; floribus sub anthesi circiter 3 cm. diametro; calyce ut pedicellis bracteolisque squamulis deltoideis ad 3 mm. longis interdum imbricatis ornatis, sepalis 5 papyraceis lanceolato-oblongis, 7–9 mm. longis, 3–4 mm. latis, apice obtusis; petalis 5 patentibus membranaceis anguste oblongis, 13–15 mm. longis, 5–6 mm. latis, integris, apice rotundatis; staminibus circiter 60 plerumque 2-seriatis 3.5–5 mm. longis, filamentis submembranaceis castaneis 1–2.5 mm. longis inferne connatis, antheris oblongis circiter 2.5 mm. longis; ovario depresso-subgloboso 2–3 mm. diametro glabro, stylis 5 basim versus in columnam crassam connatis 5–6 mm. longis superne liberis, stigmatibus minute capitatis.

British New Guinea: Central Division, Mt. Tafa, alt. 2400 m., *Brass 4878* (A, type, NY), Aug. 27, 1933 (slender tree 3–5 m. high, plentiful on forest regrowths on landslides; leaves fleshy, rough with pale fleshy processes; pedicels and sepals covered with fleshy red scales; petals white).

Saurauia rubrisquamata is best placed in the Series *Squamulosae* as a relative of *S. desquamulata* Diels and *S. Lorentzii* Lauterb.; it differs from both in the more numerous and persistent scales of its petioles, leaf-blades, inflorescences, etc., and in its much larger flowers. From *S. desquamulata* it further differs in its leaf-blades with conspicuously callose-mucronulate margins and fewer secondaries, and from *S. Lorentzii* in its proportionately broader leaf-blades. Possibly a closer relative of the new species is *S. bifida* Warb., which Diels refers to the Series *Setosae*, although it seems somewhat transitional between the two series. *Saurauia rubrisquamata* is readily distinguished from *S. bifida* by its more conspicuous, larger, and usually less pointed scales and its large flowers.

Saurauia belensis sp. nov.

Arbor parva circiter 2.5 m. alta, ramulis gracilibus purpurascentibus subteretibus juventute squamulis deltoideis obtusis circiter 1 mm. longis dispersis ornatis mox glabris; petiolis gracilibus leviter canaliculatis 7–15 mm. longis ut ramulis parce decidue squamulosis; laminis subcoriaceis obovato-ellipticis, 7–10 cm. longis, 3–4.5 cm. latis, basi obtusis et in petiolum decurrentibus, apice acuminatis (acumine angusto 5–12 mm. longo), margine anguste recurvatis et superne grosse calloso-crenulatis, utrinque glabris vel subtus disperse squamulosis, supra cellulis crystalliferis copiose ornatis, costa utrinque paullo elevata, nervis lateralibus utrinsecus 6–8 arcuato-adscendentibus supra paullo impressis

subtus prominulis, rete venularum inconspicuo supra interdum leviter impresso; inflorescentiis axillaribus cymosis ut videtur 3-floris, pedunculo gracili ad 4.5 cm. longo et pedicellis parce squamulosis, bracteis papyraceis glabris anguste obovato-oblongis circiter 10 mm. longis et 3 mm. latis, pedicellis gracilibus 1–4 cm. longis medium versus bracteolis 2 ut bracteis sed 3–6 mm. longis ornatis; floribus ubique glabris sub anthesi circiter 25 mm. diametro, segmentis perianthii cellulis crystalliferis ornatis; sepalis 5 anguste imbricatis papyraceis subaequalibus concavis suborbiculari-oblongis, 6–8 mm. longis et latis; petalis 5 submembranaceis obovato-oblongis, 13–15 mm. longis, 7–9 mm. latis, apice rotundatis vel leviter emarginatis; staminibus 80–100 plerumque 2-seriatis 3–6 mm. longis, filamentis ad 2.5 mm. longis basim versus connatis, antheris lineari-oblongis 2.5–3.5 mm. longis; ovario depresso-subgloboso circiter 3 mm. diametro pilis pallidis breviter villoso, stylis 5 gracilibus circiter 5 mm. longis ad basim liberis, stigmatibus minute capitatis.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11274* (TYPE), Nov. 1938 (tree 2.5 m. high, in rain-forest of flood-banks; flowers white).

Saurauia belensis is characterized by its essentially glabrous habit, sharply acuminate leaf-blades, large flowers, and conspicuous narrow bracts. It is apparently best placed in the Series *Squamulosae*, differing from *S. Lorentzii* Lauterb., probably its closest ally, in the above mentioned characters and its proportionately broader leaf-blades.

Saurauia albiflora sp. nov.

Arbor parva circiter 2 m. alta, ramulis gracilibus subteretibus nigrescentibus squamulas suborbiculares 0.5–1 mm. longas saepe apiculatas copiose gerentibus demum glabrescentibus; petiolis leviter canaliculatis 6–10 mm. longis ut ramulis squamulosis; laminis chartaceis siccitate fuscis oblongis vel anguste obovato-oblongis, 7–12 cm. longis, 2.5–4 cm. latis, basi acutis, apice inconspicue cuspidatis, margine subintegris vel obscure calloso-crenulatis, supra glabris (in costa interdum parce squamulosis), subtus in costa nervisque squamulis ut eis ramulorum hinc inde ornatis, costa supra acute elevata subtus prominente, nervis lateralibus utrinsecus 13–18 (cum aliis debilioribus interspersis) patentibus valde curvatis et marginem versus adscendentibus supra subplanis subtus prominulis, rete venularum inconspicuo supra interdum impresso; inflorescentiis breviter cymosis vel pseudofasciculatis ad 1.5 cm. longis 1–3-floris, pedunculo brevi pedicellisque nigrescentibus parce squamulosis glabrescentibus, bracteis anguste oblongis 2–3 mm. longis acutis, pedicellis gracilibus sub anthesi 5–9 mm. longis minute bibracteo-

latis cum calyce articulatis; floribus glabris, sepalis 5 inaequalibus concavis chartaceis suborbicularibus rotundatis, 2 exterioribus 3–3.5 mm. 2 interioribus 4–5 mm. diametro; petalis 5 patentibus submembranaceis oblongis, circiter 8 mm. longis et 4 mm. latis, apice rotundatis; staminibus numerosissimis (circiter 150) pluriseriatis, filamentis 2–4 mm. longis basim versus connatis superne filiformibus, antheris oblongis circiter 1.5 mm. longis; ovario subconico 1–1.5 mm. longo glabro, stylis 5 circiter 2 mm. longis in columnam ad apicem connatis, stigmatibus minute divaricatis.

NETHERLANDS NEW GUINEA: Balim River, alt. 1800 m., *Brass 11767* (TYPE), Dec. 1938 (tree 2 m. high, rare in sparse secondary forest; flowers white).

A member of the Series *Squamulosae, S. albiflora* is closely related only to *S. Dufaurii* (F. v. Muell.) Diels, from which it differs in its more numerous and more definitely spreading secondary nerves, its short pedicellate flowers, and the absence of scales from its calyces.

Saurauia macrantha sp. nov.

Arbor ad 22 m. alta, ramulis crassis fistulosis squamulas suborbiculares umbonatas circiter 1 mm. diametro copiose gerentibus atque aculeis ad 1.5 mm. longis hinc inde saepe armatis; foliis apicem ramulorum versus saepe aggregatis, petiolis crassis leviter canaliculatis 1–5 cm. longis squamulis ut eis ramulorum vel deltoideo-cuspidatis dense praeditis; laminis subcoriaceis siccitate fusco-olivaceis oblongis vel obovato-oblongis, 10–23 cm. longis, 4–8.5 cm. latis, basi obtusis et interdum inaequilateralibus, apice obtusis saepe apiculatis, margine dentibus inconspicuis callosis 3–7 per centimetrum crenulatis, supra praeter costam sparse umbonato-squamulosam glabris, subtus squamulis parvis umbonatis vel interdum setiformibus et patentibus praecipue in costa nervisque ornatis, costa supra prominula subtus prominente, nervis secundariis utrinsecus 12–20 arcuatis supra prominulis subtus paullo elevatis, rete venularum subimmerso; inflorescentiis axillaribus paniculatis sub anthesi 4–14 cm. longis plerumque 3–5-floris, pedunculo, bracteis, pedicellis ut ramulis squamulosis, pedunculo gracili apice flores saepe congestos gerentibus, bracteis anguste oblongis acutis ad 5 mm. longis mox caducis, pedicellis gracilibus ad 30 mm. longis, bracteolis 2 inconspicuis vel nullis; floribus sub anthesi circiter 25 mm. diametro; sepalis 5 inaequalibus, 2 exterioribus subcoriaceis oblongis apice rotundatis, 6–9 mm. longis, 6–7 mm. latis, extus squamulis adpressis deltoideo-suborbicularibus plerumque obtusis saepe mucronulatis praeditis, 3 interioribus papyraceis orbiculari-obovatis rotundatis, 12–15 mm. longis, 9–15 mm. latis, glabris

vel ad lineam medianam dorso parce squamulosis; petalis 5 glabris sub anthesi patentibus tenuiter carnosis vel submembranaceis obovato-oblongis, 13–16 mm. longis, 8–11 mm. latis, apice rotundatis; staminibus numerosissimis pluriseriatis, filamentis liberis filiformi-ligulatis gracilibus 2–4 mm. longis, antheris oblongis 2.5–3.5 mm. longis; ovario glabro conico circiter 3 mm. longo, stylis 5 ad apicem in columnam crassam circiter 5 mm. longam coalitis, stigmatibus minute capitatis subcohaerentibus.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2700–2800 m., *Brass & Versteegh 10497* (TYPE), Nov. 7, 1938 (tree 22 m. high, common in old secondary forest in a valley, the trunk 28 cm. diam., the crown not wide-spreading, the bark black, 7 mm. thick, fissured, rough, the wood yellow; flowers white), *Brass 10780* (tree to 18 m. high, frequent in older secondary forest on landslips and banks of creeks; flowers white).

Apparently a member of the Series *Squamulosae*, *S. macrantha* does not seem closely related to any described species. Its closest ally is perhaps *S. Gjellerupii* Lauterb., from which it obviously differs in its squamulate indument, the obtuse apex of its leaf-blades, its comparatively few-flowered inflorescence, and its much larger flowers. The presence of a few obscure thorns on the branchlets may indicate a relationship with such species of the Series *Armatae* as *S. sterrolepida* Diels, a species with a contracted inflorescence and much smaller flowers and leaf-blades, the latter with only 5 or 6 lateral nerves.

Saurauia fimbriata sp. nov.

Arbor 4–5 m. alta, ramulis purpurascentibus subteretibus fistulosis squamulas adpressas deltoideas ad 1.5 mm. longas obtusas margine erosulas vel fimbriatas gerentibus demum glabrescentibus; petiolis canaliculatis 1.5–4 cm. longis ut ramulis squamulosis; laminis chartaceis oblongo-ellipticis, 12–21 cm. longis, 4.5–8 cm. latis, basi obtusis, apice conspicue acuminatis (acumine ad 15 mm. longo), margine dentibus parvis spinulosis 3–5 per centimetrum crenulatis, supra siccitate fuscis glabris, subtus pallidioribus et squamulis ut eis ramulorum vel piliformibus praecipue in costa nervisque ornatis, costa supra paullo elevata subtus prominente, nervis secundariis utrinsecus 10–13 adscendentibus utrinque paullo elevatis, rete venularum intricato subtus leviter prominulo; inflorescentiis axillaribus paniculatis vel pseudocymosis 3–9-floris sub anthesi ad 8 cm. longis, pedunculo gracili ut ramulis foliatis squamulosis; squamulis bractearum, bracteolarum calycisque stramineis adpressis imbricatis oblongis vel elongato-deltoideis obtusis ad 1 mm. longis

margine saepe conspicue multifimbriatis; bracteis papyraceis oblongis 7–12 mm. longis, pedicellis ad 17 mm. longis bracteolas 2 vel 3 calyci adpressas apice gerentibus, bracteolis submembranaceis elliptico-oblongis apice rotundatis, 6–9 mm. longis, 4–7 mm. latis; sepalis 5 papyraceis vel submembranaceis concavis ellipticis, 9–10 mm. longis, 6–8 mm. latis, apice rotundatis; petalis 5 membranaceis elliptico-oblongis glabris, 10–12 mm. longis, 5–6 mm. latis, apice plerumque emarginatis; staminibus 100–125, 2- vel 3-seriatis 3.5–5.5 mm. longis, filamentis membranaceis 1.5–3 mm. longis basim versus connatis superne ligulato-filiformibus, antheris lineari-oblongis 2–2.5 mm. longis acutis; ovario subgloboso 2–3 mm. diametro pilis pallidis circiter 1 mm. longis dense tomentoso, stylis 5 triente inferiore coalitis 4–5 mm. longis superne gracilibus, stigmatibus capitatis.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13394* (TYPE), March 1939 (tree 4–5 m. high, common in young seral growths on sandy flood-banks in rain-forest; flowers white).

Saurauia fimbriata is a very distinct species of the Series *Squamulosae*, readily distinguished by its conspicuous (but scarcely enveloping) bracts and bracteoles, which, together with the sepals, are densely squamulate with imbricate and beautifully fimbriate scales. Its closest relative may be *S. iboana* Diels, from which it differs in its proportionately broader leaf-blades, more numerous flowers, and pubescent ovary, as well as in the scales of the inflorescence.

Saurauia Schumanniana Diels in Bot. Jahrb. **57**: 448. 1922.

Saurauia rosea Lauterb. & K. Schum. in K. Schum. & Lauterb. Fl. Deutsch. Schutzg. Südsee 446. 1901; Rechinger in Denkschr. Akad. Wiss. Wien **89**: 579. 1913; non *S. rosea* Jungh. (1841).

SOLOMON ISLANDS: Bougainville: Keita, near sea-level, *Kajewski 1527*. Florida (N'Gela): alt. 50 m., *Brass 3506*. Ysabel: Meringe, alt. 250 m., *Brass 3188*. Guadalcanal: Uulolo, Tutuve Mt., alt. 1200 m., *Kajewski 2523*. San Cristoval: Huro River, *Brass 2608;* Hinuahaoro, alt. 900 m., *Brass 3038*.

Saurauia Schumanniana has previously been reported from several collections in Northeastern New Guinea and also from Bougainville (by Rechinger). It appears to occur in some abundance in the Solomons, where Brass and Kajewski report it as a large shrub or a small tree sometimes up to 12 m. high, with white or pale pink petals. A common name is *teng-eng-sorsor* (Guadalcanal).

Saurauia purgans Burtt, as represented by *Waterhouse 33* (Y, type

coll.) from Bougainville, is very close to *S. Schumanniana* and doubtfully distinct from it. The hairs of the calyx are slightly denser, crisper, and more spreading than those found on the above-cited specimens, but this is a character of dubious specific value in *Saurauia*.

Saurauia holotricha Diels in Bot. Jahrb. **57**: 450. 1922.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1750 m., *Brass 12228* (small tree to 3 m. high, common in rain-forest gullies; branches spreading; flowers white).

The species has previously been reported only from the neighboring Sepik region in Northeastern New Guinea. Our specimen agrees very well with the original description in all details except its somewhat shorter sepals.

Saurauia Dielsiana sp. nov.

Arbor parva ad 6 m. alta, ramulis gracilibus subteretibus fistulosis juventute pilis ad 2 mm. longis dense setosis vel strigosis demum glabrescentibus; petiolis gracilibus 10–15 mm. longis ut ramulis pubescentibus; laminis chartaceis obovato-ellipticis, 8–16 cm. longis, 3–6 cm. latis, basi acutis, apice cuspidatis vel acuminatis (acumine ad 1 cm. longo), margine dentibus parvis spinulosis numerosis inconspicue crenulatis, supra fuscis breviter strigosis demum glabrescentibus, subtus pilis pallide brunneis crispulis simplicibus 0.5–1 mm. longis ubique et uniformiter setosis vel strigosis, costa supra paullo elevata subtus prominente, nervis secondariis utrinsecus 8–12 arcuatis vel adscendentibus supra subplanis subtus prominulis, venulis plerumque planis; inflorescentiis axillaribus paniculatis sub anthesi 4–9 cm. longis plerumque 6–12(–25)-floris, pedunculo, ramulis, pedicellis sepalisque ut ramulis foliatis pubescentibus (pilis ad 2 mm. longis); bracteis papyraceis extus vel utrinque setosis nunc foliaceis et ad 15 mm. longis et 6 mm. latis nunc linearioblongis vel ellipticis et 3–6 mm. longis demum caducis; pedicellis gracilibus ad 13 mm. longis bracteolas 2 ut bracteas sed 2–5 mm. longas caducas gerentibus; sepalis 5 papyraceis oblongis, 5–7 mm. longis, 3–4 mm. latis, apice obtusis vel acutis, interioribus margine glabris; petalis 5 membranaceis glabris oblongis, 6–11 mm. longis, 3–4 mm. latis, apice leviter emarginatis vel rotundatis; staminibus plerumque 100–150 et pluriseriatis 2–4 mm. longis, filamentis ligulato-filiformibus 1–2.5 mm. longis basim versus cohaerentibus, antheris dorsifixis oblongis 1–1.8 mm. longis acutis; ovario glabro depresso-subgloboso 2–4 mm. diametro, stylis 5 infra medium vel basi coalitis 3–4 mm. longis superne liberis et gracilibus, stigmatibus minute capitatis.

BRITISH NEW GUINEA: Central Division, Mafulu, alt. 1250 m., *Brass 5414* (A, TYPE, NY), Nov. 1, 1933 (common small tree of secondary forest growths; flowers white); Mt. Tafa, alt. 2400 m., *Brass 4837* (A, NY) (tree 2.5–3 m. high, common on brushy banks of a gully in forest; leaves dull; flowers pale pink); Eastern Division, U-uma River headwaters, *Brass 1462* (tree to 6 m. high, in riverine rain-forest; leaves pale and prominently nerved beneath; flowers pink).

I cannot agree with Diels (in Jour. Arnold Arb. **10:** 241. 1929) in referring *Brass 1462* to *S. Andreana* (F. v. Muell.) Oliver of Queensland, which, however, is apparently a closely related species. *Saurauia Dielsiana* differs from *S. Andreana* in having its inflorescence much longer, freely branched, and with many (rather than 1–3) flowers, its pedicels longer, and its petals oblong rather than obovate or orbicular-obovate. Both species are perhaps best referred to the Series *Setosae;* among Papuasian species of this series, *S. holotricha* Diels is related to the new species but differs in the long setose hairs of its branchlets, petioles, and leaf-nerves, its shorter inflorescence, larger flowers, etc. *Saurauia Dielsiana* also bears a resemblance to such species of the Series *Rufae* as *S. egregia* Diels, from which it differs in its lack of swollen scales on the branchlets, the simple hairs of the lower surfaces of leaves, its acute leaf-base, fewer secondaries, etc.

Brass 4837, occurring at higher elevations than the other two specimens cited, disagrees with them in having slightly longer pubescence, more ascending secondaries, longer petals, and fewer stamens; these differences appear to me of little more than individual consequence and are included in the description.

Saurauia Kajewskii sp. nov.

Arbor parva ad 10 m. alta, ramulis purpurascentibus fistulosis juventute pilis circiter 2 mm. longis densissime adpresso-strigosis mox glabrescentibus; petiolis 15–22 mm. longis ut ramulis strigosis; laminis chartaceis oblongo-ellipticis, 14–23 cm. longis, 6–10 cm. latis, basi obtusis, apice acuminatis (acumine conspicuo ad 15 mm. longo), margine dentibus callosis et setosis inconspicuis 6–8 per centimetrum ornatis, utrinque praecipue subtus pilis subadpressis 1–2 mm. longis sericeis vel crispulo-strigosis indutis, costa utrinque elevata, nervis secundariis utrinsecus 10–13 arcuato-adscendentibus supra planis subtus prominulis, venulis inconspicuis; inflorescentiis axillaribus vel e ramulis infra folia orientibus paniculatis sub anthesi 5–10 cm. longis 3–9-floris, pedunculo, ramulis, pedicellis, bracteis, bracteolis sepalisque ut ramulis foliatis dense ferrugineo-strigosis; bracteis linearibus circiter 10 mm. longis et

2 mm. latis, bracteolis infra medium pedicellorum sed minoribus, pedicellis gracilibus 10–25 mm. longis; sepalis 5 subcoriaceis deltoideo-oblongis acutis sub fructu ad 10 mm. longis et 6–8 mm. latis; petalis 5 submembranaceis oblongis, 8–10 mm. longis, apice leviter emarginatis; staminibus numerosissimis pluriseriatis 2–4 mm. longis, filamentis ligulatis 1.5–2.5 mm. longis basi cohaerentibus, antheris anguste oblongis obtusis 1.5–2 mm. longis; ovario depresso-subgloboso glabro, stylis 5 circiter 4 mm. longis ad basim liberis, stigmatibus minute capitatis.

SOLOMON ISLANDS: Bougainville: Kupei Village, alt. 750 m., *Kajewski 1726* (TYPE), April 16, 1930 (small tree to 10 m. high, common in rain-forest; petals white; anthers yellow; fruit light green, depressed-globose, about 11 by 15 mm., the pericarp more or less transparent).

Saurauia Kajewskii falls into the Series *Setosae* and appears related to *S. holotricha* Diels and the preceding new species (*S. Dielsiana*). From the former it differs in the closer and subappressed (rather than spreading) hairs of branchlets, leaves, and inflorescences, in its larger leaf-blades, more copiously branching inflorescences, and proportionately broader sepals. From the latter it is readily distinguished by the more copious pubescence throughout, the larger leaf-blades, fewer and larger flowers, etc. *Saurauia Kajewskii* is not closely related to the few other species known from the Solomons.

Saurauia Brassii Diels in Jour. Arnold Arb. **10:** 81, 240. 1929.

BRITISH NEW GUINEA: Central Division, Kubuna, alt. 100 m., *Brass 5624* (A, NY) (erect small tree, not common, in forest on river-bank; branches few; flowers white).

The second collection of this species agrees perfectly with the type, having its leaf-blades, however, up to 40 cm. long and 15 cm. broad. As flowers were lacking from the original collection, I add a description of the inflorescences:

Inflorescences loosely short-paniculate, 1.5–4 cm. long at anthesis, arising from defoliate branchlets, the few branches, bracts, pedicels, and bracteoles sparsely puberulent and soon glabrous; bracts and bracteoles oblong, obtuse, 1–2 mm. long; pedicels slender, 5–20 mm. long, the flowers at anthesis 15–18 mm. in diameter; sepals 5, erecto-patent, papyraceous, elliptic or obovate, 6–7 mm. long, 4–5 mm. broad, rounded at apex, sparsely puberulent and soon glabrous; petals 5, subspreading, submembranous, obovate-oblong, 8–9 mm. long, 3–4 mm. broad, usually emarginate at apex; stamens about 100, 3–4 mm. long, 2–4-seriate, the filaments membranous, 1.5–2.5 mm. long, firmly connate toward base, the anthers narrowly oblong, 2–2.5 mm. long, dehiscing by short oval

pores; ovary glabrous, subglobose, 2–2.5 mm. in diameter at anthesis, the styles 5, about 3.5 mm. long, free nearly to base, the stigmas minutely capitate.

Saurauia collina sp. nov.

Arbor circiter 3 m. alta, ramulis subteretibus apicem versus ad 7 mm. diametro et pilis 4–7 mm. longis densissime setosis demum glabrescentibus et papilloso-rugulosis; petiolis ad 12 mm. longis ut ramulis setosis; laminis chartaceis anguste obovato-oblongis, 11–19 cm. longis, 3.5–6 cm. latis, basi obtusis, apice abrupte cuspidatis vel breviter acuminatis, margine pilis 5–8 per centimetrum ad 3 mm. longis calloso-setulosis ornatis, utrinque praecipue in costa parce strigosis (pilis 2–3 mm. longis) demum subglabris, costa utrinque elevata, nervis lateralibus utrinsecus circiter 11 arcuato-adscendentibus supra planis subtus elevatis, rete venularum interdum subtus leviter prominulo; floribus paucis ut videtur subfasciculatis vel breviter paniculatis, bracteis bracteolisque parvis setosis, pedicellis gracilibus ad 11 mm. longis pilis circiter 1.5 mm. longis setosis; floribus ubique glabris, sepalis 5 papyraceis oblongis, 5–7 mm. longis, 3–4 mm. latis, apice obtusis, interioribus marginem versus scariosis; petalis 5 submembranaceis oblongis, 6–7 mm. longis, 2.5–3 mm. latis, apice rotundatis vel leviter emarginatis; staminibus 35–40 uniseriatis 3.5–5 mm. longis, filamentis submembranaceis ligulatis 1.5–2.5 mm. longis laxe connatis, antheris oblongis 2–3 mm. longis, tubulis apicem versus distinctis; ovario glabro subgloboso circiter 3 mm. diametro, stylis 5 fere ad basim liberis circiter 3 mm. longis, stigmatibus capitatis.

British New Guinea: Central Division, Iawarere, alt. about 350 m., *Brass 667* (type), Nov. 22, 1925 (small tree about 3 m. high, in foothill forest; petals pink).

The cited specimen was merely referred to the genus by Diels (in Jour. Arnold Arb. **10:** 241. 1929), doubtless because of the scarcity of flowers on the specimen. In spite of this, the material is sufficiently ample to indicate that an undescribed species of the Series *Setosae* is represented. Its relationship is with *S. Brassii* Diels, from which it differs in the finer and denser hair-like paleae of the distal portions of its branchlets, its strigose rather than essentially glabrous leaf-blades, its setose pedicel, and its slightly smaller flowers with fewer stamens and with filaments laterally connate in a single series.

Saurauia idenburgensis sp. nov.

Arbor parva 2–3 m. alta, ramulis subteretibus gracilibus apicem versus pilis ad 8 mm. longis densissime setosis demum glabrescentibus; petiolis

crassis 12–25 mm. longis ut ramulis setosis; laminis papyraceis lanceolato-obovatis, 20–30 cm. longis, 5.5–7.5 cm. latis, basi gradatim attenuatis, apice acutis vel inconspicue acuminatis, margine integris setosis, utrinque praecipue in costa nervisque pilis longis setuliferis strigosis (pilis costae subtus copiosis patentibus curvatis 3–7 mm. longis), costa supra elevata subtus prominente, nervis lateralibus utrinsecus 13–16 arcuato-adscendentibus utrinque valde prominulis, rete venularum inconspicuo utrinque interdum leviter prominulo; inflorescentiis paucis apicem ramulorum versus axillaribus ad 5 cm. longis ut videtur 1–3-floris, pedunculo, bracteis pedicellisque pilis patentibus 3–7 mm. longis dense et conspicue setosis; bracteis papyraceis lanceolatis, 15–18 mm. longis, circiter 3 mm. latis, pedicellis 5–8 mm. longis, bracteolis 2 ut bracteis sed circiter 10 mm. longis mox caducis; floribus sub anthesi circiter 4 cm. diametro, sepalis 5 erecto-patentibus papyraceis oblongis, 13–15 mm. longis, 5–7 mm. latis, extus dense setosis (pilis circiter 3 mm. longis patentibus curvatis), apice obtusis, interioribus marginem versus scariosis; petalis 5 membranaceis anguste spathulato-oblongis, circiter 22 mm. longis et 8 mm. latis, basim versus ad 4 mm. angustatis, apice rotundatis vel leviter emarginatis; staminibus numerosis (60–80) 2- vel 3-seriatis 5–8 mm. longis, filamentis stramineis 3–5 mm. longis basim versus connatis superne anguste ligulatis, antheris basim versus dorsifixis oblongis 3–4 mm. longis acutis; ovario depresso-subgloboso 3–4 mm. diametro minute et dense tomentello, stylis 5 in columnam crassam coalitis circiter 5 mm. longis apicem versus liberis, stigmatibus minute capitatis.

NETHERLANDS NEW GUINEA: 6 km. southwest of Bernhard Camp, Idenburg River, alt. 1200 m., *Brass 12977* (TYPE), Feb. 1939 (tree 2–3 m. high, frequent in rain-forest undergrowth of gullies and ridges; petals pinkish white).

A member of the Series *Setosae*, *S. idenburgensis* is related to *S. amplifolia* Diels, *S. mollissima* Ridley, and *S. mamberamana* Diels, differing from them in details of pubescence and leaf-shape, its few secondary nerves, its large flowers, etc.

Saurauia Archboldiana sp. nov.

Arbor parva circiter 2 m. alta, ramulis crassis subteretibus fistulosis squamulis stramineis lanceolatis (3–6 mm. longis, basi 0.5–1 mm. latis) imbricatis subadpressis dense indutis demum glabrescentibus; petiolis crassis 5–10 mm. longis anguste alatis ut ramulis squamulas minores gerentibus; laminis chartaceis obovato-oblongis, 15–27 cm. longis, 6.5–8.5 cm. latis, basim versus gradatim angustatis, basi ipso obtusis et in petiolum decurrentibus, apice subacutis vel breviter cuspidatis, mar-

gine dentibus spinulosis 3–5 per centimetrum inconspicue serratis, utrinque praecipue in costa nervisque pilis brevibus interdum subsquamulaceis adpressis disperse strigosis, costa supra subplana vel leviter depressa subtus prominente, nervis secundariis utrinsecus 15–27 erecto-patentibus supra subplanis subtus valde prominulis, venulis subtus saepe leviter prominulis; inflorescentiis axillaribus sub anthesi circiter 4 cm. longis plerumque 3-floris, pedunculo, bracteis, pedicellis sepalisque dense et conspicue setosis (pilis subadpressis vel subpatentibus complanatis ad 6 mm. longis); bracteis papyraceis ellipticis foliaceis ad 25 mm. longis et 15 mm. latis interdum multo minoribus, pedicellis ad 25 mm. longis; floribus sub anthesi 3–4 cm. diametro, sepalis 5 subcoriaceis oblongis, 11–13 mm. longis, 5–7 mm. latis, apice rotundatis vel obtusis, marginem versus saepe scariosis; petalis tenuiter carnosis vel submembranaceis oblongis, 17–19 mm. longis, 7–10 mm. latis, apice rotundatis vel leviter emarginatis; staminibus numerosis (80–100) 2- vel 3-seriatis 5–7 mm. longis, filamentis 2.5–4 mm. longis basi interdum subcohaerentibus, antheris dorsifixis anguste oblongis 4–4.5 mm. longis, tubulis apicem versus distinctis; ovario glabro subconico circiter 4 mm. diametro, stylis 5 fere ad basim liberis circiter 5 mm. longis, stigmatibus minute capitatis.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, alt. 2300 m., *Brass 11231* (TYPE), Nov. 1938 (tree 2 m. high, occasional in moist sheltered hollows in forest undergrowth; flowers white).

Saurauia Archboldiana, belonging in the Series *Setosae,* is characterized by its large many-nerved leaf-blades which are short-strigose on both surfaces, its few-flowered inflorescences with elongate setae, and its large flowers. Probably belonging in the same group as the preceding new species (*S. idenburgensis*), *S. Archboldiana* differs from that and its allies not only in its indument, but also in its large bracts, glabrous ovary, etc.

Saurauia sterrolepida Diels in Bot. Jahrb. **57:** 453. 1922.

NETHERLANDS NEW GUINEA: Lake Habbema, alt. 3225 m., *Brass 9353* (erect small tree or shrub 3–4 m. high, common along streams in forest; flowers white); 9 km. northeast of Lake Habbema, alt. 2900 m., *Brass 10705* (compact small tree to 2 m. high, common in shrubby forest openings on wet sandy soil; flowers white); Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11079* (low tree about 2 m. high, abundant in grassy second forest growth; leaves stiff; flowers white; fruit red).

Although this species, originally reported from a single collection from

the Bismarck Mountains, is known to me only from the description, I have little hesitation in referring to it the cited specimens. The species is well marked by its stout spines, small leaves, and compact inflorescences.

Saurauia alpicola sp. nov.

Arbor ad 5 m. alta, ramulis crassis aculeis paucis ad 2 mm. longis hinc inde armatis atque squamulis orbiculari-deltoideis spinulosis ad 1 mm. longis imbricatis dense praeditis demum glabrescentibus; petiolis crassis 10–20 mm. longis ut ramulis dense squamulosis; laminis subcoriaceis anguste oblongis, 8–18 cm. longis, 3–6 cm. latis, basi obtusis, apice breviter cuspidatis, margine dentibus parvis calloso-spinulosis 4–7 per centimetrum inconspicue crenulatis, supra glabris, subtus squamulis minutis interdum spinulosis vel fimbriatis disperse scabrido-papillosis, in costa subtus etiam interdum aculeatis, costa supra paullo impressa subtus prominente, nervis secondariis utrinsecus 12–20 arcuatis supra leviter insculptis subtus prominulis, rete venularum subimmerso; inflorescentiis apicem ramulorum versus axillaribus sub anthesi 5–13 cm. longis plerumque 1–3-floris, pedunculo, bracteis pedicellisque aculeis numerosis ad 1.5 mm. longis valde papilloso-rugosis, pedunculo crasso ad 9 cm. longo; bracteis subcoriaceis oblongis 15–20 mm. longis, pedicellis ad 25 mm. longis sed plerumque multo brevioribus, bracteolis mox caducis; floribus sub anthesi 5–6 cm. diametro; sepalis 5 valde inaequalibus, 2 exterioribus coriaceis obtusis oblongis, 10–14 mm. longis, 7–10 mm. latis, extus dense spinulosis (spinulis crassis ad 1.5 mm. longis interdum minoribus et squamulaceis), 3 interioribus tenuiter carnosis vel submembranaceis obovato-ellipticis, 18–28 mm. longis, 15–25 mm. latis, apice rotundatis, glabris vel tertio partim spinuloso; petalis 5 carnosis patentibus obovato-ellipticis, 22–30 mm. longis, 15–23 mm. latis, apice profunde emarginatis; staminibus numerosis (circiter 125) 2- vel 3-seriatis subaequalibus 7–8 mm. longis, filamentis anguste ligulatis 3.5–5 mm. longis liberis vel basi cohaerentibus, antheris pallidis dorsifixis crassis oblongis, 3–3.5 mm. longis; ovario glabro breviter conico 3–4 mm. diametro, stylis 12–13 mm. longis in columnam crassam triquetram omnino connatis, stigmatibus 3 subconnatis, loculis 3.

NETHERLANDS NEW GUINEA: Lake Habbema, alt. 3225 m., *Brass 9140* (common marginal tree 4–5 m. high, in forest of moist hollows; branches erect and armed with prickles; flowers pale green); 7 km. northeast of Wilhemina-top, alt. 3560 m., *Brass & Myer-Drees 9952* (TYPE), Sept. 1938 (flat-topped tree 5 m. high, represented by several examples in soil-pockets on a warm cliff-face; flowers greenish white).

Saurauia alpicola, belonging in the Series *Armatae,* is characterized by having the large leaf-blades conspicuously papillose-scabrid beneath with peculiar scale-like fimbriate papillae, the peduncle, pedicels, and outer sepals conspicuously rugose-spinescent, the flowers very large in all parts, and the styles 3 and completely connate. These characters amply distinguish the new species from the known species of the *Armatae,* to none of which it seems closely related.

Saurauia tafana sp. nov.

Frutex vel arbor parva 2–4 m. alta, ramulis subteretibus juventute pilis ferrugineis circiter 1 mm. longis basi incrassatis dense setosis demum glabrescentibus; petiolis gracilibus 13–18 mm. longis ut ramulis densissime et breviter setosis; laminis chartaceis oblongo-ellipticis, 8–13 cm. longis, 3–5 cm. latis, basi subacutis, apice breviter cuspidatis, margine integris et copiose setosis, utrinque praecipue in costa nervisque pilis ad 1 mm. longis dense ferrugineo-hirsutis (pilis supra subadpressis subtus patentibus) costa supra subplana subtus prominente, nervis lateralibus utrinsecus 7–10 arcuato-adscendentibus supra subplanis subtus elevatis, rete venularum subtus saepe prominulo; inflorescentiis axillaribus sub anthesi 3–10 cm. longis plerumque 3-floris, pedunculo, bracteis, pedicellis bracteolisque pilis 0.5–1 mm. longis dense ferrugineo-setosis; pedunculo ad 7 mm. longo, bracteis papyraceis breviter stipitatis elliptico-oblongis ad 10 mm. longis et 4 mm. latis, pedicellis ad 15 mm. longis, bracteolis ut bracteis sed minoribus; sepalis 5 subcoriaceis obtusis oblongis, 7–9 mm. longis, 5–7 mm. latis, extus pilis circiter 4 mm. longis dense setoso-strigosis; petalis 5 erecto-patentibus submembranaceis vel papyraceis oblongis, 13–15 mm. longis, circiter 6 mm. latis, apice rotundatis vel leviter emarginatis; staminibus numerosis (120–140) 3–6 mm. longis plerumque 3-seriatis, filamentis subcoriaceis 2–4 mm. longis inferne connatis superne anguste ligulatis, antheris basifixis oblongis 2–3 mm. longis; ovario glabro depresso-globoso sub anthesi circiter 6 mm. diametro, stylis 5 basim versus in columnam crassam coalitis circiter 6 mm. longis in triente superiore liberis, stigmatibus capitatis.

British New Guinea: Central Division, Mt. Tafa, alt. 2400 m., *Brass 4963* (A, type, NY), Sept. 3, 1933 (bush or small tree 2–4 m. high, very common in forest secondary growths on clearings; indument of inflorescence and lower leaf-surface red; leaf-blades pale brown-pubescent above; petals white, pink-tinged).

Saurauia tafana is probably best placed in the Series *Rufae,* where it seems most closely related to *S. buddleifolia* Diels, differing in having its leaf-blades cuspidate (rather than obtuse) at apex and subacute (rather

than subrotund) at base, its secondary nerves fewer, its flowers obviously pedicellate, and its styles more highly connate. The new species also bears a resemblance to *S. Poolei* White & Francis, placed in the Series *Setosae* by its describers, but differs in its denser and longer tomentum throughout, its narrower and differently shaped leaf-blades, partially connate styles, etc.

Saurauia arcana sp. nov.

Arbor parva circiter 2 m. alta, ramulis gracilibus subteretibus juventute squamulis pallidis angustis fragilibus 2–3 mm. longis acutis praeditis mox glabrescentibus; petiolis gracilibus canaliculatis 1–3 cm. longis supra saepe breviter squamulatis mox glabris; laminis papyraceis obovato-oblongis, 8–16 cm. longis, 3.5–6 cm. latis, basi acutis, apice breviter cuspidatis, margine integris et setis curvatis ad 2 mm. longis basi incrassatis 3–5 per centimetrum ornatis, supra costa pallide squamulosa excepta inconspicue papilloso-rugosis vel glabris, subtus primo praecipue in costa pallide et arcte lanatis mox glabris, costa utrinque elevata, nervis secondariis utrinsecus 11–15 arcuato-adscendentibus utrinque prominulis, rete venularum inconspicuo; inflorescentiis simplicibus paucis axillaribus sub anthesi 3–7 cm. longis 1–3-floris, pedunculo gracili saepe squamulis subadpressis 1–1.5 mm. longis mox caducis sparse setoso-squamulato ac etiam arcte et pallide tomentello demum glabrescente; bracteis 2 conspicuis papyraceis inconspicue reticulato-nervatis circiter 18 mm. longis apiculatis mox glabrescentibus, basi connatis, ante anthesim flores includentibus; pedicellis subnullis, sepalis 5 submembranaceis vel papyraceis orbiculari-oblongis, 8–14 mm. longis, 6–12 mm. latis, apice rotundatis, marginem versus saepe scariosis, utrinque dense et pallide tomentellis glabrescentibus, ubique cellulis crystalliferis aureis numerosis ornatis; petalis 5 membranaceis glabris obovato-oblongis, 18–22 mm. longis, 12–14 mm. latis, apicem versus undulato-rotundatis; staminibus 80–100 valde inaequalibus 5–10 mm. longis plerumque 3-seriatis, filamentis membranaceis 3–7 mm. longis basim versus connatis, antheris dorsifixis oblongis 2.5–3 mm. longis acutis; ovario depresso-subconico sub anthesi 3–4 mm. diametro dense et pallide tomentello, stylis 3 basim versus in columnam crassam coalitis 7–8 mm. longis superne liberis, stigmatibus capitatis.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1800 m., *Brass 12034* (TYPE), Jan. 1939 (tree 2 m. high, in undergrowth of a ravine; flowers white).

The new species, referable to the Series *Bibracteatae,* is closely related to the only previously described species of this group, *S. bibracteata*

Lauterb., differing in its thinner and smaller leaf-blades with longer petioles and in its sessile and much larger flowers.

Saurauia congestiflora sp. nov.

Arbor ad 15 m. alta, ramulis gracilibus purpurascentibus subteretibus juventute squamulis peltato-ellipticis ad 1 mm. longis breviter fimbriatis dense ornatis demum glabrescentibus; petiolus gracilibus 1.5–4 cm. longis ut ramulis decidue squamulatis; laminis chartaceis elliptico-oblongis, 13–26 cm. longis, 5–10 cm. latis, basi obtusis et saepe inaequilateralibus, apice subacutis vel breviter cuspidatis, margine dentibus minutis callosis 5 vel 6 per centimetrum ornatis, supra glabris et cellulis crystalliferis copiose praeditis, subtus squamulis minutis ferrugineis copiosissime fimbriatis dense tomentellis demum subglabris, costa supra leviter paullo elevata subtus prominente, nervis secondariis utrinsecus 12–20 erecto-patentibus supra prominulis subtus elevatis, rete venularum conspicuo supra leviter subtus valde prominulo; inflorescentiis compactis axillaribus sub anthesi 4–8 cm. longis circiter 20-floris, pedunculo gracili ad 6 cm. longo et bracteis ut foliorum facie inferiore squamulatis; bracteis 2 vel 3 submembranaceis conspicue nervatis late ovatis circiter 2 cm. longis et latis, margine calloso-serrulatis, apice subacutis, ante anthesim flores includentibus; bracteolis numerosis ut bracteis sed minoribus, saepe circiter 10 mm. longis et 3 mm. latis; pedicellis gracilibus ad 5 mm. longis squamulis fimbriatis dense ferrugineo-tomentellis; sepalis 5 papyraceis vel submembranaceis obovato-oblongis, 7–9 mm. longis, 4–5 mm. latis, apice obtusis, extus pilis circiter 1 mm. longis adpresso-setosis ac etiam arcte squamuloso-tomentellis; petalis 5 membranaceis oblongis circiter 10 mm. longis et 5–6 mm. latis, apice rotundatis vel leviter emarginatis, margine saepe undulatis; staminibus circiter 50 plerumque 2-seriatis 3–6 mm. longis, filamentis gracilibus 2–4 mm. longis basi connatis superne filiformibus, antheris crassis oblongis 1.5–2 mm. longis; ovario ovoideo sub anthesi circiter 4 mm. longo glabro, stylis 5 ad basim liberis circiter 5 mm. longis, stigmatibus minute capitatis.

NORTHEASTERN NEW GUINEA: Morobe District, Sattelberg, alt. about 900 m., *Clemens 340* (TYPE), Oct. 4, 1935 (tree about 12 m. high, in hillside forest, the trunk about 15 cm. diam.; flowers white), *Clemens 436* (tree about 15 m. high, at head of stream in forest, the trunk about 20 cm. diam.; flowers white).

This striking species is characterized by having the indument of its leaves, bracts, etc. made up of densely fimbriate minute scales, by its numerous flowers, and by its submembranous conspicuously nerved

bracts. I believe that it is best placed in the Series *Bibracteatae,* but it sharply differs from *S. bibracteata* Lauterb. and *S. arcana* (above described) in its tomentellous branchlets and leaves, its different bracts and bracteoles, its appressed-setose as well as tomentellous sepals, and its 5 styles. Possibly the new species should be referred to the Series *Obvallatae,* but here also it appears to be without close relatives.

Saurauia eburnea sp. nov.

Arbor ad 6 m. alta, ramulis crassis rugosis juventute dense et pallide tomentellis mox glabris; petiolis crassis anguste alatis 1–2 cm. longis glabris vel primo evanescenti-tomentellis; laminis coriaceis glabris siccitate olivaceis anguste elongato-obovatis, 18–27 cm. longis, 4–7 cm. latis, basim versus gradatim attenuatis et in petiolum decurrentibus, apice breviter cuspidatis, margine dentibus calloso-spinulosis 2–4 per centimetrum serratis, costa valida supra paullo elevata subtus prominente, nervis secondariis utrinsecus 18–27 arcuato-adscendentibus cum aliis debilioribus interspersis supra insculptis vel leviter prominulis subtus paullo elevatis, rete venularum copioso conspicuo utrinque subplano vel supra impresso; inflorescentiis simplicibus axillaribus sub anthesi 12–19 cm. longis, floribus summo pedunculi 8–12 aggregatis, pedunculo gracili ad 16 cm. longo glabro vel squamulis pallidis evanescentibus parvis obtusis ornato apice bibracteato, bracteis subcoriaceis orbiculari-oblongis rotundatis ad 22 mm. diametro ante anthesim flores includentibus; pedicellis sub anthesi 15–25 mm. longis rugulosis arcte et pallide tomentellis demum glabrescentibus, bracteolis evanescentibus vel nullis, floribus sub anthesi circiter 25 mm. diametro; sepalis 5 papyraceis ovato-ellipticis 5–6 mm. longis et latis, apice rotundatis, marginem versus scariosis, extus puberulis glabrescentibus; petalis 5 submembranaceis vel papyraceis obovato-oblongis, 10–12 mm. longis, 8–9 mm. latis, apice plerumque emarginatis; staminibus circiter 50 plerumque 2-seriatis 3.5–4 mm. longis, filamentis ligulatis membranaceis 2–3 mm. longis basi cohaerentibus, antheris crassis oblongis circiter 2 mm. longis medium versus dorsifixis saepe recurvatis; ovario glabro truncato-conico sub anthesi 4–5 mm. diametro, summo conspicue 5-sulcato, stylis circiter 2 mm. longis in columnam crassam omnino connatis, stigmatibus in pelta coalitis; fructibus carnosis ut videtur ovoideis ad 15 mm. diametro.

BRITISH NEW GUINEA: Central Division, Mt. Tafa, alt. 2400 m., *Brass 4872* (A, TYPE, NY), Aug. 26, 1933 (spreading stiffly branched tree up to 6 m. high, common in secondary forest on old landslides; leaves shining, with red margins; corolla cream colored; fruit fleshy, red, dehiscing at apex).

Saurauia eburnea is readily distinguished by its elongate glabrous

leaves with winged petioles, its long peduncles surmounted by conspicuous coriaceous bracts and a cluster of numerous flowers, and its closely tomentellous pedicels. It appears to be a member of the Series *Bibracteatae,* in which it is obviously different from *S. bibracteata* Lauterb. and *S. arcana* (above described) in foliage and inflorescence characters, its 5 completely connate styles, etc. The new species also bears a resemblance to such members of the Series *Squamulosae* as *S. Gjellerupii* Lauterb. and *S. plurilocularis* White & Francis, but differs from them in its bracts, numerous flowers, and many other details.

Saurauia pleurotricha Diels in Jour. Arnold Arb. **10:** 80, 240. 1929.

British New Guinea: Fly River, 528-mile Camp, alt. 80 m., *Brass 6851* (large loosely branched shrub 2.5 m. high, at head of a heavily shaded gully; branchlets, leaves, and inflorescence densely covered with coarse red hairs).

The cited specimen, the second referable to the species, agrees well with the type from the Vailala River; its leaf-blades are slightly longer in proportion and more obviously acuminate, and its peduncle is up to 5 cm. long.

Saurauia capitulata sp. nov.

Arbor 6–18 m. alta, ramulis subteretibus aculeis validis 2–4 mm. longis saepe curvatis armatis atque juventute squamulis peltato-ellipticis umbonatis fimbriatis ad 1 mm. longis dense obtectis; petiolis crassis (6–)10–28 mm. longis ut ramulis squamulosis et interdum aculeatis; laminis subcoriaceis elliptico- vel obovato-oblongis, 7–21 cm. longis, 3.5–11.5 cm. latis, basi rotundatis vel obtusis, apice rotundatis vel breviter cuspidatis, margine dentibus parvis callosis et interdum spinulosis 2–4 per centimetrum ornatis, supra juventute pilis ad 6 mm. longis spinuloso-strigosis mox glabris, subtus densissime ferrugineo-pannosis, costa leviter elevata subtus prominente, nervis secundariis utrinsecus 10–16 erecto-patentibus subrectis supra prominulis subtus valde elevatis, rete venularum utrinque paullo prominulo subtus tomento obscuro; inflorescentiis simplicibus axillaribus sub anthesi 6–12 cm. longis, floribus summo pedunculi 2–10 aggregatis, pedunculo gracili rugoso-squamulato vel aculeis ad 1.5 mm. longis recurvatis interdum copiose armato apice 2- vel 3-bracteato; bracteis persistentibus coriaceis suborbicularibus, 8–10 mm. longis, 9–13 mm. latis, basi connatis, apice rotundatis vel obtusis, ut pedunculo spinulosis vel squamulatis atque interdum pallide tomentellis, flores juveniles includentibus; floribus congestis sessilibus sub anthesi circiter 2 cm. diametro, bracteolis papyraceis acutis oblongis circiter 10 mm. longis et 6 mm. latis extus dense adpresso-

setosis atque tomentellis; sepalis 5 papyraceis concavis elliptico-oblongis, 7–9 mm. longis, 4–6 mm. latis, apice rotundatis, margine saepe scariosis, exterioribus pilis complanatis 3–6 mm. longis dense adpresso-setosis atque interdum tomentellis, interioribus saepe glabris; corolla subrotata circiter 15 mm. longa, petalis 5 vel 6 basim versus connatis membranaceis obovato-oblongis, 5–9 mm. latis, apice rotundatis vel emarginatis; staminibus 80–150 circiter 6 mm. longis 2- vel 3-seriatis, filamentis ligulato-filiformibus 4–5.5 mm. longis basim corollae adnatis, antheris dorsifixis oblongis 1.5–2 mm. longis obtusis saepe recurvatis; ovario glabro ovoideo-conico circiter 3 mm. diametro, stylis 5 in columnam crassam inferne coalitis 6–7 mm. longis apicem versus liberis gracilibus, stigmatibus minute capitatis.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2600–2750 m., *Brass & Versteegh 10465* (tree about 12 m. high, rare on banks of streams in secondary forest, the trunk 30 cm. diam., the crown very small, the bark 4 mm. thick, blackish brown, scaly, the wood white), *Brass 10698* (TYPE), Oct. 1938 (tree to about 18 m. high, common in secondary forest on landslips, etc.; leaves stiff, convex; flowers white), *Brass 10843* (tree 6 m. high, on bank of a forest stream; leaves convex; flowers white); Balim River, alt. 2100 m., *Brass & Versteegh 11178* (tree 10 m. high, on edge of a landslip in forest, the trunk 28 cm. diam., the crown not wide-spreading, the bark 7 mm. thick, scaly, dark brown; flowers white).

Saurauia capitulata is clearly a member of the Series *Obvallatae*, but I have not been able to find a description which satisfactorily fits the specimens. A close relative seems to be *S. rufa* Burkill (which appears to belong in this series rather than in the "*Rufae*" of Diels), a species occurring at lower elevation in British New Guinea; from this *S. capitulata* differs in its longer petioles and larger leaf-blades, sessile flowers, more numerous stamens, and styles connate except at apex. Other related species are *S. hystrix* Ridley and *S. achyrantha* Diels. From the first of these the new species differs in its longer petioles, its smaller leaf-blades which are obtuse or rounded at base, its shorter peduncles, smaller sepals, and glabrous petals. *Saurauia capitulata* differs from *S. achyrantha* in its arborescent habit, the presence of spines on its branchlets, petioles, peduncles, etc., its shorter petioles, smaller leaf-blades, bracts which are squamulate or spinulose but hardly setose, smaller inflorescences, sessile and smaller flowers, and glabrous ovary. It is not yet possible to evaluate the constancy of these characters without many more specimens, but in my present opinion the mentioned species of this alliance seem well founded.

Saurauia occulta sp. nov.

Arbor ad 10 m. alta, ramulis gracilibus subteretibus fistulosis aculeis brevibus disperse armatis ac etiam juventute squamulis coriaceis deltoideis acutis interdum spinulosis 0.5–2 mm. longis dense indutis demum glabrescentibus; petiolis gracilibus 7–20 mm. longis ut ramulis spinuloso-squamulatis; laminis subcoriaceis elliptico-oblongis, 7–16 cm. longis, 3–7.5 cm. latis, basi obtusis, apice obtusis vel breviter cuspidatis, margine dentibus callosis 3–8 per centimetrum crenulato-serratis, supra costa inferne interdum spinuloso-squamulata excepta glabris, subtus pilis simplicibus subspinulosis ad 1.5 mm. longis disperse setosis atque in costa deltoideo-squamulatis, costa supra valde prominula subtus prominente, nervis secundariis utrinsecus 10–14 erecto-patentibus supra prominulis subtus valde elevatis, rete venularum conspicuo utrinque prominulo; inflorescentiis simplicibus axillaribus sub anthesi 3–8 cm. longis, floribus summo pedunculi gracilis ut ramulis squamulati plerumque 5–8 aggregatis; bracteis 2–4 papyraceis ellipticis, 7–10 mm. longis, 3–7 mm. latis, saepe connatis et flores juveniles includentibus, apice subacutis, margine breviter setosis, extus squamulis elongato-deltoideis cuspidatis circiter 1 mm. longis ornatis atque interdum setosis; pedicellis crassis sub anthesi 5–7 mm. longis squamulatis, floribus sub anthesi 15–20 mm. diametro, bracteolis inconspicuis vel subnullis; sepalis 5 papyraceis vel submembranaceis oblongis, 6–7 mm. longis, circiter 4 mm. latis, apice obtusis, extus pilis stramineis rigidis 2–4 mm. longis dense sericeo-setosis; petalis 5 glabris membranaceis obovato-oblongis, 9–12 mm. longis, 5–6 mm. latis, apice rotundatis vel leviter emarginatis; staminibus circiter 60 plerumque 2-seriatis 3–4.5 mm. longis, filamentis 2–3 mm. longis basim versus connatis superne liberis et filiformi-ligulatis, antheris oblongis circiter 1.5 mm. longis; ovario glabro subgloboso 2–2.5 mm. diametro, stylis 5 circiter 3 mm. longis ad medium in columnam crassam coalitis superne gracilibus, stigmatibus minute capitatis.

Netherlands New Guinea: Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11208* (type), Nov. 1938 (one of the principal trees in young secondary forest, about 10 m. high; bark brown, fibrous and fissured; flowers white); 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1800 m., *Brass 12063* (tree 2 m. high, in secondary forest; flowers white).

A member of the Series *Obvallatae*, *S. occulta* is closely related only to *S. scaberrima* Lauterb., differing in its more slender branchlets and petioles, the smaller and sparser spines of its branchlets, the lack of spines on its leaves, the obtuse rather than subcordate leaf-base, the pedicellate flowers, and the less obvious setae of its bracts. These two

species are readily separated from the preceding (*S. capitulata*) and its allies by the sparser and stiffer tomentum of the lower surfaces of leaf-blades.

Saurauia conferta Warb. in Bot. Jahrb. **13:** 379. 1891; K. Schum. & Lauterb. Fl. Deutsch. Schutzg. Südsee 445. 1901, op. cit. Nachtr. 317. 1905; Lauterb. in Nova Guinea Bot. **8:** 305. 1910, op. cit. **8:** 835. 1912; Diels in Bot. Jahrb. **57:** 458. 1922; Diels in Nova Guinea Bot. **14:** 84. 1924; Lane-Poole, Rep. For. Res. Papua 116. 1925; White & Francis in Proc. Roy. Soc. Queensl. **39:** 65. 1928; Diels in Jour. Arnold Arb. **10:** 241. 1929.

SOLOMON ISLANDS: Bougainville: Kugumaru, Buin, alt. 150 m., *Kajewski 1976;* Kupei Gold Field, alt. 600–950 m., *Kajewski 1632, 1645.* Ysabel: Tiratona, alt. 600 m., *Brass 3228.* Guadalcanal: Ululolo, Tutuve Mt., alt. 1200 m., *Kajewski 2596;* Sorvorhio basin, alt. 200 m., *Kajewski 2706.* San Cristoval: Waimamura, *Brass 2657.*

Although *S. conferta* is known to be abundant in New Guinea and is reported from Neu-Mecklenburg, the cited specimens appear to be the first records from the Solomon Islands, where the species is said to be common in rain-forest at comparatively low elevations. Kajewski and Brass report the plant as a small tree up to 15 m. high, with waxy-white petals. Common names are: *kekeu-mor-mokiu* (Bougainville), *geota* (Ysabel), and *him-mulla* or *heina-muller* (Guadalcanal).

OCHNACEAE

SCHUURMANSIA Bl.

In his treatment of the family, Gilg (in Engl. & Prantl, Nat. Pfl. ed. 2. **21:** 80. 1925) has given a key to the species of *Schuurmansia* in which he has introduced four new names for New Guinean species. As the brief mention of foliage characters given in the key hardly permits identification, and as no specimens are cited, it is probably best to consider these names *nomina subnuda* until they are more adequately published. From a study of Gilg's brief key, I conclude that none of the three new species which I propose below will conflict with the plants named by him.

Schuurmansia longifolia (Lauterb.) Gilg in Engl. & Prantl, Nat. Pfl. ed. 2. **21:** 80. 1925.

Schuurmansia Bamleri var. *longifolia* Lauterb. in K. Schum. & Lauterb. Nachtr. Fl. Deutsch. Schutzg. Südsee 318. 1905; Hall. f. in Rec. Trav. Bot. Néerl. **10:** 351. 1913.

Solomon Islands: Bougainville: Kupei Gold Field, alt. 100 m., *Kajewski 1692* (straight tree about 4 m. high, in rain-forest, the inflorescences and foliage terminal; petals light greenish pink; stamens bright yellow). San Cristoval: Hinuahaoro, mountain rain-forest, alt. 900 m., *Brass 3018* (sparsely branched tree 10 m. high, the branches thick, leaf-scarred, the leaves shining); Star Harbour, hill-forest, alt. 50 m., *Brass 3112* (slender sparsely branched tree 10 m. high, uncommon; leaves in dense clusters toward end of branches, persistent for several seasons in clusters separated by a few inches).

The species has previously been reported only from a single collection on Neu-Mecklenburg. To the best of my knowledge, the cited specimens are the first representatives of the Ochnaceae reported from the Solomon Islands.

Schuurmansia coriacea sp. nov.

Arbor pauciramosa ad 3 m. alta ubique glabra, ramulis teretibus fuscis rugosis apicem versus 5–6 mm. diametro; foliis ad apices ramulorum in verticillis circiter 8 congestis, petiolis gracilibus 15–20 mm. longis angustissime alatis basi paullo incrassatis, laminis coriaceis siccitate fuscis lanceolato-obovatis, 10–14 cm. longis, 3–4.5 cm. latis, basi gradatim attenuatis et in petiolum decurrentibus, apice rotundatis et saepe minute calloso-apiculatis, margine incrassatis anguste revolutis nigro-calloso-serrulatis (callosis parvis 6–8 per centimetrum), costa utrinque prominente, nervis lateralibus crebris (2–4 per centimetrum, cum aliis paullo debilioribus interspersis) erecto-patentibus rectis nervo marginali crasso conjunctis supra subplanis vel subtiliter prominulis subtus leviter elevatis, rete venularum subtili saepe immerso; inflorescentiis paniculatis terminalibus multifloris ad 20 cm. longis et 25 cm. latis, basi bracteis paucis papyraceis ad 8 mm. longis fimbriatis subtentis; pedunculo circiter 3 cm. longo bracteis (vel stipulis?) 3–4 mm. longis conspicue fimbriatis ornato, rhachi leviter angulata, ramulis patentibus bracteis caducis subtentis; floribus ♂ sub anthesi 8–10 mm. diametro, pedicellis gracilibus 2–4 mm. longis prope medium articulatis et saepe minute bibracteolatis; sepalis membranaceis pellucido-glandulosis elliptico-obovatis, 4–4.5 mm. longis, 3–4 mm. latis, apice rotundatis, marginem versus scariosis, margine ipso integris vel distaliter obscure erosulosis; petalis membranaceis late elliptico-obovatis, circiter 6 mm. longis et 4–5 mm. latis, inconspicue 9–11-nervatis, rotundatis, integris; staminodiis inconspicuis 30–40 (basi filamentorum 6–8 aggregatis) membranaceis lineari-oblongis circiter 1 mm. longis; staminibus 5, filamentis carnosis 2–2.5 mm. longis, antheris oblongis 1.5–2 mm. longis obscure

mucronulatis; gynaecii rudimento ovoideo circiter 1 mm. longo, stylo stigmatibusque inconspicuis.

BRITISH NEW GUINEA: Central Division, Mt. Tafa, alt. 2400 m., *Brass 5076* (TYPE), May–Sept. 1933 (small sparsely branched tree 3 m. high, rare on landslip regrowths; leaves pale, smooth; flowers cream colored).

Schuurmansia coriacea appears to be a very distinct species, characterized by its small coriaceous leaf-blades with the venation essentially plane above and the margins thickened and copiously callose-serrulate, and its ample inflorescence with fimbriate bracts, large flowers, small clustered staminodes, and comparatively long filaments. It is thus amply differentiated from what is probably its closest ally, *S. rauwolfioides* Hall. f., which furthermore differs from the new species in its obtusely acuminate and membranaceous-chartaceous leaf-blades.

Schuurmansia montana sp. nov.

Arbor ad 8 m. alta ubique glabra, ramulis crassis (apicem versus 6–9 mm. diametro) fuscis rugosis fistulosis, cicatricibus foliorum delapsorum ornatis; foliis apicem ramulorum versus in verticillis 2–3 cm. distantibus congestis, petiolis crassis 5–20 mm. longis anguste alatis leviter complanatis basi incrassatis, laminis coriaceis fuscis anguste obovatis, (5–)7–10 cm. longis, (1.5–)2–3.5 cm. latis, basi attenuatis et in petiolum decurrentibus, apice rotundatis vel interdum inconspicue emarginatis vel calloso-apiculatis, margine revolutis et conspicue nigro-calloso-serrulatis (callosis parvis 5–8 per centimetrum), costa supra elevata subtus prominente, nervis secundariis crebris cum aliis paullo debilioribus interspersis erecto-patentibus in marginem incrassatum conjunctis utrinque manifeste prominulis, rete venularum subtili utrinque prominulo vel subtus interdum subimmerso; inflorescentiis paniculatis terminalibus multifloris ad 20 cm. longis et 14 cm. latis, bracteis mox caducis, pedunculo nullo, rhachi et ramulis adscendentibus complanatis vel leviter angulatis; floribus ♀ sub anthesi 7–9 mm. diametro, pedicellis crassis 2–6 mm. longis prope medium articulatis; sepalis papyraceis crassis pellucido-glandulosis ellipticis, 3.5–4.5 mm. longis, 3–3.5 mm. latis, circiter 7-nervatis, marginem versus scariosis, margine ipso obscure erosulosis; petalis membranaceis obovatis, 5–6 mm. longis, 3.5–4 mm. latis, rotundatis, inconspicue circiter 7-nervatis; staminodiis numerosis (70–80) imbricatis 2- vel 3-seriatis lineari-oblongis membranaceis, interioribus 1–1.3 mm. longis; staminibus (ut videtur sterilibus) 5, filamentis circiter 0.3 mm. longis, antheris oblongis circiter 1 mm. longis obscure mucronulatis; ovario nigrescenti subgloboso-ovoideo sub anthesi

circiter 3 mm. longo, stylo crasso circiter 0.8 mm. longo, stigmatibus 3 patentibus ovatis (circiter 0.7 mm. longis et latis) obtusis arcte sericeis; pedicellis sub fructu paullo incrassatis, staminodiis persistentibus, capsulis obovoideo-ellipsoideis ad 13 mm. longis et 7 mm. latis, stylo incrassato, seminibus aliis inclusis circiter 5 mm. longis.

BRITISH NEW GUINEA: Central Division, Murray Pass, Wharton Range, alt. 2840 m., *Brass 4706* (sparsely branched tree up to 8 m. high, erect, common in open type of low forest; leaves dull, convex; fruit reddish), *Brass 4743* (TYPE), June–Sept. 1933 (erect tree to 7 m. high, common on forest-fringes and in more open parts of low forest; leaves smooth, pale beneath; flowers white).

Schuurmansia montana is a large-flowered montane species, closely related only to the preceding (*S. coriacea*), but differing in its smaller and conspicuously convex leaf-blades with shorter and stouter petioles, its obviously prominulous veinlets, and its thicker sepals. Of the cited specimens, *4743* bears pistillate flowers and *4706* is in fruit, and so a floral comparison with *S. coriacea* is not conclusive. The new species has an unusually large number of staminodes in the pistillate flower, and the nigrescent ovary and large ovate stigmas are also unusual. *Schuurmansia montana* is perhaps to be compared with *S. lophiroides* Gilg (in Engl. & Prantl, Nat. Pfl. ed. 2. **21**: 80, nomen subnudum. 1925).

Schuurmansia grandiflora sp. nov.

Arbor parva ubique glabra, ramulis apicem versus ad 7 mm. crassis fistulosis subteretibus fuscis; foliis ad apices ramulorum in verticillis circiter 8 congestis, petiolis crassis ad 10 mm. longis complanatis et conspicue alatis basi incrassatis, laminis subcoriaceis siccitate fuscis elongato-obovatis, 11–18 cm. longis, 4–6 cm. latis, basi gradatim attenuatis et in petiolum conspicue decurrentibus, apice obtusis vel obtuse cuspidatis, margine incrassatis integris vel obscure et sparse calloso-serrulatis, costa utrinque valde elevata, nervis secundariis crebris cum aliis paullo debilioribus interspersis erecto-patentibus in marginem conjunctis utrinque valde prominulis, rete venularum subtili utrinque manifeste prominulo; inflorescentiis paniculatis multiramosis multifloris ad 17 cm. longis et 14 cm. latis, pedunculo brevi crasso cicatricibus bracteatarum delapsarum ornato, rhachi ramulisque leviter angulatis; floribus ♂ sub anthesi 10–13 mm. diametro, pedicellis gracilibus 2–3 mm. longis basim versus articulatis; sepalis papyraceis oblongo-ellipticis, 4.5–5.5 mm. longis, 2–3 mm. latis, apice rotundatis, pellucido-punctatis; petalis membranaceis obovato-ellipticis, 6.5–7 mm. longis, 3.5–4.5 mm. latis, inconspicue 10–12-nervatis, apice rotundatis, integris; staminodiis cir-

citer 40 lineari-lanceolatis circiter 1 mm. longis; staminibus 5, filamentis circiter 2 mm. longis, antheris oblongis 2.5–3 mm. longis obscure apiculatis; gynaecii rudimento subgloboso circiter 0.5 mm. diametro, stylo stigmatibusque inconspicuis.

BRITISH NEW GUINEA: Central Division, Owen Stanley Range, alt. about 1800 m., *Lane-Poole 371* (TYPE), Feb. 1923.

Although the type of the new species is one of the collections cited by Lane-Poole (Rep. For. Res. Papua 116. 1925) and by White and Francis (in Proc. Roy. Soc. Queensl. **38**: 247. 1927) as *S. Henningsii* K. Schum., it sharply differs from that species in its small leaf-blades and especially in its much larger flowers, both sepals and petals being nearly twice as large as those of *S. Henningsii* and its sepals being much thicker in texture. Two other collections of Lane-Poole have been cited as *S. Henningsii*, but I have no specimens of these to compare with the new species. The large sepals of *S. grandiflora*, as well as details of leaf-size, venation, and margins amply distinguish it from *S. Gilgiana* Lauterb. and the two new species described above.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

PLANTAE PAPUANAE ARCHBOLDIANAE, VIII*

E. D. Merrill and L. M. Perry

We had hoped to include in this paper the Anacardiaceae and the Staphyleaceae. The latter are represented by only nine collections of *Turpinia* Vent. from New Guinea. Since we found no record of that genus from Papuasia, it was necessary to reorganize our material in the search for determinative characters. The identification of our New Guinean collections will be included in a short summary of the compound-leaved species of *Turpinia* Vent. in the Old World. Amongst the Anacardiaceae some specimens of *Campnosperma* Thwaites offer an interesting verification of the record of a much earlier collection, Scheffer, Ann. Jard. Bot. Buitenz. **1**: 17. 1876. In *Semecarpus* L. f., too, one species is conspicuous by its fruits. These are so different in shape from the usually compressed fruits that we have considered once more the status of the genus *Oncocarpus* A. Gray. Dr. C. Heimsch very kindly examined the wood-structure and the pollen for us. Although *Oncocarpus* A. Gray undoubtedly represents a good section, we do not find at present sufficient evidence to maintain it as a genus. The paper also contains another record of the Corynocarpaceae.

ANACARDIACEAE

Buchanania Sprengel

Buchanania mollis Lauterb. Nov. Guin. **8**: 829. 1912, Bot. Jahrb. **56**: 349. 1920; Kaneh. & Hatus. Bot. Mag. Tokyo **52**: 413. 1938.

British New Guinea: Central Division, Ononge Road, Dieni, *Brass 3866,* April 1933, alt. 500 m., common in rain-forests (erect tree 25 m. tall, with close grey bark; branchlets brown; leaves shining above, pubescent beneath, midrib pale; flowers green; fruit immature). Northeastern New Guinea: Wareo, *Clemens 1801,* February 1936, alt. ± 750 m.

The type was from Netherlands New Guinea; Kanehira has also collected the species in the Bismarck Archipelago.

*Botanical Results of the Richard Archbold Expeditions. See Jour. Arnold Arb. **22**: 375–388. 1941.

Buchanania macrocarpa Lauterb. Bot. Jahrb. **56**: 350. 1920.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, *Brass & Versteegh 13553*, April 1939, alt. 50 m., frequent in primary rain-forest on lower mountain slopes (tree 32 m. high, 48 cm. diameter; bark grey-brown with a little light resin; flowers yellow; fruit greenish brown). BRITISH NEW GUINEA: Palmer River, 2 miles below Black River Junction, *Brass 7342*, July 1936, alt. 100 m., plentiful in forests of river flood plains (large buttressed tree over 30 m.; bark brown, reddish when cut, crown sparse. A good floating timber very suitable for the construction of rafts).

Although we have only the original description for comparison, there seems little doubt that *Brass & Versteegh 13553* belongs to this species. In the material from British New Guinea the lower surface of the leaves is ± minutely pubescent; the fruit (perhaps not yet full grown) is only about 15 mm. diameter; nevertheless, at present, the collection seems better placed here than elsewhere.

Buchanania solomonensis sp. nov.

Arbor usque 20 m. alta; ramulis atro-fuscis, innovationibus adpresse pubescentibus, mox glabratis; foliis glabris coriaceis, inconspicue reticulatis, petiolatis petiolo 4–5 cm. longo basi crassiusculo, elongato-oblanceolatis vel lanceolatis, 16–35 cm. longis, 5–11 cm. latis, basim versus cuneatim angustatis, breviter decurrentibus, apice breviter acuminatis, margine integris ac leviter revolutis; venis primariis utrinsecus 17–27, supra distinctis, subtus prominentibus, patentibus, ± parallelis, prope marginem sursum versis, secundariis inconspicue manifestis; paniculis subterminalibus atque axillaribus, in fructu 15–30 cm. longis, ± pubescentibus vel glabratis; floribus sessilibus vel subsessilibus; calycis segmentis rotundatis, 0.6–0.8 mm. longis; petalis oblongis, 2.5–3 mm. longis; disco 1.5–2 mm. longo; filamentis subulatis, antheris sagittatis 0.8 mm. longis, lobis basalibus quam loculis brevioribus; carpellis 5, sterilibus 2 mm. longis, gynoecio minute piloso; drupis lentiformibus, ± 1.2 cm. diametro, lateraliter compressis, glabratis, apiculo centrico, in sicco scrobiculato-rugosis.

SOLOMON ISLANDS: Bougainville Island: Kugumaru, Buin, *Kajewski 1873* (TYPE), June 1930, alt. 150 m., common in rain-forest (medium sized tree up to 15 m. high; fruit shining black when ripe, flattened, 1.2 cm. long and broad, 5 mm. thick); Koniguru, Buin, *Kajewski 2123*, August 1930, alt. 1200 m., common in rain-forest (large tree up to 20 m. high, growing in the better forest areas; fruit green suffused with pink near the end, 1.3 cm. long, 1.1 cm. broad, 8 mm.

thick). San Cristobal Island: Magoha River, *Brass 2745,* August 1932, riverine rain-forest, common in lowlands (stiffly branched tree 10 m. tall; branches purple-brown; leaves very dark, smooth and shining, pale beneath; fruit purple).

In foliar characters, the species is much like *Buchanania mangoides* F. v. Mueller and *B. novo-hibernica* Lauterb. In the latter, the gynoecium is glabrous, in *B. solomonensis* it is pubescent. The floral description was drawn up from the remnants of a flower found attached to one of the fruits. One complete anther was found, in this the basal lobes were about ⅓ the length of the anther or ½ the length of the locules, also the pubescence of the gynoecium is short: these two characters distinguish our species from *B. mangoides* F. v. Muell.

Buchanania Versteeghii sp. nov.

Arbor circiter 29 m. alta; ramulis atro-fuscis; foliis coriaceis, petiolatis petiolo circiter 1.5 cm. longo basi paullo incrassato, obovatis, 7–12 cm. longis, ultra medium 3.5–5 cm. latis, basi cuneatis, apice breviter atque interdum oblique acuminatis, margine integro undulato revoluto, utrinque glabris vel subtus costa venisque consperse pilosis; venis primariis utrinsecus 9–16 patentibus deinde subabrupte ad marginem incurvantibus, prominentibus, secundariis a primariis oblique abeuntibus, supra inconspicuis, subtus manifestis; paniculis subterminalibus 9–16 cm. longis fusco-tomentulosis, bracteis subulatis 5 mm. longis deciduis; floribus breviter pedicellatis; calyce glabro, lobis oblongis circiter 0.6 mm. longis; petalis ovatis 2.5 mm. longis (in floribus visis valde recurvatis); filamentis 1 mm. longis subulatis, antheris 0.6 mm. longis sagittatis, lobulis thecarum vix productis; disco urceolato 0.4 mm. longo ± sulcato; carpellis 5, gynoecio strigoso-piloso; drupis immaturis 6–8 mm. diametro subglobosis, lateraliter compressis, apiculo centrico.

Netherlands New Guinea: 4 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13161* (type), March 1939, alt. 800 m., occasional in primary rain-forest on flood plain (tree 29 m. high, 60 cm. diameter; bark black; flowers yellow-green; fruit green).

Among Papuasian species of *Buchanania,* this suggests *B. montana* Lauterb. in foliar characters, but it is readily distinguished from the latter by the subtomentose inflorescence. Lauterbach carefully pointed out that *B. montana* Lauterb. is a tree of the mossy forest. *B. Versteeghii* is found in the rain-forest.

Buchanania heterophylla K. Schum. var. **pubescens** var. nov.

A forma typica recedit foliis subtus praecipue costa venisque consperse pubescentibus.

BRITISH NEW GUINEA: Lower Fly River, east bank opposite Sturt Island, *Brass 8044* (TYPE), October 1936, rain-forest, restricted to the flood-plains (large canopy tree; stem cylindric; bark thick, brown, exfoliating in small hard scales and exuding a clear brown resin when cut; leaves clustered at ends of branches; fruit red).

Except for the scattered pubescence remaining in the lower surface of the leaves, this collection compares favorably with that of *Brass 1636* from the Lower Mori River; in the latter, however, the leaves are entirely glabrous. The short-acuminate leaves of *Brass 8044* are up to 55 cm. long and 16 cm. broad.

Mangifera Linnaeus

Mangifera minor Blume Mus. Bot. Lugd.-Bat. **1:** 198. 1850; Lauterb. Bot. Jahrb. **56:** 353. 1920; C. T. White, Proc. Roy. Soc. Queensl. **34:** 40. 1922; Lane-Poole Rept. For. Res. Papua 107. 1925; White & Francis, Proc. Roy. Soc. Queensl. **38:** 237. 1927; C. T. White, Jour. Arnold Arb. **10:** 234. 1929; Kaneh. Jour. Dept. Agric. Kyushu Univ. **4:** 355. 1935.

SOLOMON ISLANDS: Bougainville Island: Kugumaru, Buin, *Kajewski 1930,* July 1930, alt. 150 m., common in rain-forest; Koniguru, Buin, *Kajewski 2157,* July 1930, alt. 600 m., common in rain-forest.

This species has been reported from New Guinea, the Bismarck Archipelago, Micronesia and Polynesia, but apparently not before from the Solomon Islands.

? **Mangifera inocarpoides** sp. nov.

Arbor 12 m. alta glabra; foliis subcoriaceis subnitidis, utrinque prominule reticulatis, oblongo-lanceolatis vel oblongis, 19–24 cm. longis, 4.5–7.5 cm. latis, basi cuneatis, apice acutis ac apiculatis; venis primariis utrinsecus ± 25, patentibus, marginem versus arcuatis; petiolo 3.5–4.5 cm. longo; inflorescentiis terminalibus 18 cm. longis, parce ramosis; fructibus subrotundis, valde compressis, paullo obliquis, non apiculatis, 6 cm. longis, 6.5 cm. latis, 4 cm. crassis; pericarpio 3–4 mm. crasso fibroso, endocarpio membranaceo; semine oblique reniformi vel oblongo, compresso, infra hilum laterale abrupte angustato atque producto, hic embryone locato; testa rugosa chartacea; embryone parvo, cotyledonibus conferruminatis, valde ruminatis.

BRITISH NEW GUINEA: Western Division, Penzara, between Morehead and Wassi Kussa Rivers, *Brass 8462* (TYPE), December 1936,

plentiful in rain-forest fringing creeks (tree up to 12 m. high; fruit much compressed, 6–8 cm. diameter, 3.5–4 cm. thick).

This is a fruiting collection from which all the parts of the flowers have fallen, and the seed is well developed. The general outline of the fruit is that of *Inocarpus,* but we find neither the style-scar nor the characteristic ridge found on the fruit of this leguminous genus. Yet, it must be admitted that the cotyledons of *Mangifera* L. are smooth and uniform in consistency. On the contrary, when the seed of this species is cut into two parts, the cotyledons are marked more or less regularly with narrow streaks. We have not found any comment on the occurrence of this ruminate character in the genus *Mangifera* L. Possibly when flowers are available some other generic disposition of this species may be indicated.

Spondias Linnaeus

Although we have no range-extensions to record in *Spondias* L., we simply note that the genus is represented in Papuasia by two species, *S. dulcis* Forst. and *S. pinnata* (L. f.) Kurz. The latter species is listed by previous students of the Papuasian flora as *S. mangifera* Willd. As a matter of fact both names appear in the literature of Indo-Malaysia; it may be of interest to point out that both are based on *Mangifera pinnata* Koen. & Linn. f. Suppl. 156. 1781. Kurz's use of the earliest specific epithet validates his combination.

Campnosperma Thwaites

In studying the genus *Campnosperma* Thwaites, we find that *C. philippinensis* Merr. (*Wenzel 3199,* from Surigao) appears to be *Buchanania nitida* Engler. *Campnosperma* Thwaites, at present, is not known to occur in the Philippine Islands or Java, although it is to be looked for. The genus ranges from the Malay Peninsula, Penang, Sumatra, and Borneo to New Guinea and the Caroline Islands, and is here recorded for the first time from the Solomon Islands.

Campnosperma montana Lauterb. Bot. Jahrb. **56:** 359. 1920.

Netherlands New Guinea: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12541,* February 1939, alt. 1200 m., common on slopes in the rain-forest (tree 27 m. high; flowers yellow; fruit dark red); 4 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13131,* March 1939, alt. 900 m., common in *Agathis* forest (tree 25 m. high, 49 cm. diameter; bark brown; resin colorless; flowers light yellow; fruit green); *Brass & Versteegh 13145,* alt. 900 m.,

common in mossy forest (tree 20 m. high; bark brown, scaly; flowers yellow; fruit black); *Brass 13338*, alt. 900 m., occasional in *Agathis* forest (subsidiary tree 20 m. high; flowers green). BRITISH NEW GUINEA: Palmer River, 2 miles below Black River Junction, *Brass 7091, 7130, 7169*, June 1936, alt. 100 m., abundant in canopy layer of ridge forests (spur-buttressed tree up to 30 m. high; bark grey, somewhat flaky, lenticellate; leaves clustered at the apex of the branchlets; flowers green; fruit smooth, green, immature, ± 1.2 cm. diameter).

We have found only minor differences in these collections from various altitudes and possibly habitats. In the plants of low altitude the pubescence tends to be more obviously stellate-lepidote, the leaves are practically all retuse or rounded at the apex, and perhaps a little more decurrent down the petiole; these are only minor variations. We believe the cited collections represent a single species.

Campnosperma macrophylla (Blume) Hook. f. Fl. Brit. Ind. **2**: 41. 1876; Engler in DC. Monog. Phan. **4**: 316. 1883; Lauterb. Bot. Jahrb. **56**: 359. 1920; Corner, Gard. Bull. Straits Settl. **10**: 254. 1939.

Buchanania macrophylla Blume, Mus. Bot. Lugd.-Bat. **1**: 185. 1850; Scheffer, Ann. Jard. Bot. Buitenz. **1**: 17. 1876; F. v. Muell. Pap. Pl. **1**: 54. 1876.

BRITISH NEW GUINEA: Palmer River, 2 miles below Black River Junction, *Brass 7117*, June 1936, alt. 100 m., chief dominant of a special swamp-forest found on a broad plateau-like ridge (straight slender tree 30 m. tall, with small open crown of sparsely foliaged semi-erect branches, and producing numerous slender-kneed pneumatophores from a few cm. to over 1 m. high; stem spur-buttressed or with prop-roots at the base; bark brown, lenticellate, vertically furrowed; leaves stiff, concave, shining above, brown pubescent beneath; flowers green; fruit immature); Gaima, Lower Fly River (east bank), *Brass 8292*, November 1936, forming pure open stands in reed swamps within rain-forests (erect tree 20 m. high; bark brown, hard, furrowed, pink when cut; wood pale pink; young leaves brown beneath; ripe fruit smooth, black, soft, fleshy, up to 18 mm. long, 16.5 mm. diameter).

This species has been reported from Papuasia only on the basis of a single sterile specimen (hence doubtfully determined) collected by Teysmann on the island of Méoswar in Geelvink Bay, according to Scheffer, F. v. Mueller, and Lauterbach. The two collections above cited show both ♀ flowers and fruit; consequently, there should be little question concerning their identity, if we have interpreted the descrip-

tions and herbarium specimens of *C. macrophylla* (Bl.) Hook. f. correctly. The leaves are a little smaller (11–18 cm. long, 7–9 cm. broad) with fewer primary veins (13–22). Although these collections seem clearly to be conspecific, it should be noted that, in one, the lower surface of the leaves is covered with stellate (or fasciculate) hairs, obvious to the eye, as well as with smaller stellate scales; in the other collection occasional stellate hairs are present on the leaves; the young ones, although covered closely with the brown stellate scales, have the longer indumentum only on the petioles.

Corner's work is the most recent treatment of the genus; unfortunately for us, he restricts his consideration to those species occurring in the Malay Peninsula.

Campnosperma auriculata (Bl.) Hook. f. Fl. Brit. Ind. **2:** 41. 1876; Engler in DC. Monog. Phan. **4:** 320. 1883; Corner, Gard. Bull. Straits Settl. **10:** 253. 1939.

Buchanania auriculata Blume Mus. Bot. Lugd.-Bat. **1:** 185. 1850.

Netherlands New Guinea: Bernhard Camp, Idenburg River, *Brass 13963,* April 1939, alt. 50–60 m., plentiful in rain-forests on higher levels of flooded plains and on moist alluvial flats not subject to inundation (large prominently buttressed tree 30–50 m. high; flowers green. The soft, not very durable wood was used by the expedition for making canoes). Previously collected in the Malay Peninsula, Sumatra, and Borneo.

Campnosperma Brassii sp. nov.

Arbor magna; innovationibus dense stellato-pubescentibus; foliis chartaceis vel tenuiter coriaceis, subsessilibus, petiolo vix 1 cm. longo auriculato, auriculis inconspicuis, 5 mm. diametro, ± rotundatis, dense stellato-pubescentibus, lamina oblanceolata, 15–40 cm. longa, 6–12 cm. lata, in parte inferiore deorsum gradatim elongato-angustata, basi supra auriculis rotundata, apice rotundata, margine integra, supra glabra, crebre manifeste reticulata, subtus praecipue venis venulisque ± minute stellato-pilosa; venis primariis utrinsecus 20–26, utrinque prominulis, late patenti-adscendentibus, parallelis, propè marginem sursum versis; paniculis axillaribus 15 cm. (in fructu 35 cm.) longis, dense et minute stellato-pilosis, ramulis inferioribus usque 7 cm. longis, bracteis ovatis acutis; floribus ♀ breviter pedicellatis tetrameris; calycis segmentis stellato-pubescentibus late ovatis, acutiusculis, circiter 0.5 mm. longis; petalis glabris ovatis 1 mm. longis obtusis; disco glabro crasso; staminibus 0.6 mm. longis, antheris parvis; ovario obtuse conico, in parte inferiore stellato-pubescente, stigmate ± distincte lobato; drupis ovoideis 5 mm. longis 4 mm. diametro glabris.

SOLOMON ISLANDS: Ysabel Island: Garona, *Brass 3355* (TYPE), December 1932, riverine rain-forests, common in lowlands (tall spreading tree attaining a large size; old trees with flange buttresses and rough bark; branches leaf-scarred; leaves densely clustered at ends of branches, upper surface shining, lower brown, nerves on upper side very pale; flowers greenish; fruit smooth, brown, glandular-dotted, flesh oily; sap oily; one of the most conspicuous lowland trees).

This species differs from *Campnosperma macrophylla* (Blume) Hook. f., the other known pubescent Malaysian species, in that the leaves are almost sessile and auricled. The petals are glabrous, the disk is thicker, the ovary is sparsely pubescent, and the fruit is much smaller. The lamina of the leaf is 5 mm. wide on either side of the midrib in the lower part, which corresponds to the winged petiole in *C. auriculata* (Bl.) Hook. f., a species with glabrous leaves. Apparently this is the first collection of the genus in the Solomon Islands.

Rhus Linnaeus

Rhus taitensis Guillem. Ann. Sci. Nat. Bot. II. **7**: 361. 1837; A. Gray, Bot. U. S. Expl. Exped. 368. 1854; Merr. Enum. Philip. Fl. Pl. **2**: 473. 1923; Kaneh. Fl. Micrones. 185. *f. 76.* 1933; Christophersen, Bishop Mus. Bull. **128**: 127. 1935.

Rhus rufa Teysm. & Binn. Nat. Tijdschr. **27**: 52. 1863.
Rhus panaciformis F. v. Muell. Fragm. Phytogr. Austr. **7**: 22. 1869–71.
Rhus retusa Zoll. ex Engl. in DC. Monog. Phan. 450. 1883, and β *Blumei* Engler l.c.
Rhus Engleriana Warb. Bot. Jahrb. **13**: 363. 1891.
Rhus retusa var. *rufa* Koorders & Valeton, Meded. Lands Plant. **19**: 412. 1898.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, *Brass 13726,* March 1939, alt. 850 m., rain-forest, common in older seral growths on river banks (tree ± 15 m. high, 20 cm. diameter); Bernhard Camp, Idenburg River, *Brass & Versteegh 14123,* May 1939, alt. 70 m., in primary forest of flood plain (tree 24 m. high, 44 cm. diameter; bark grey-brown with some white sap; wood reddish brown). BRITISH NEW GUINEA: Central Division, Laloki River, Rona, *Brass 3674,* March 1933, alt. 450 m., plentiful in borders of rain-forests and in light gully forests (erect tree up to 15 m. high, with stiffly spreading branches; bark pale grey-brown, slightly fissured and flaky; sap milky; flowers white); Eastern Division, Lower Mori River, *Brass 1577,* May 1926 (tree 40–50 feet, with pale close grey bark; flowers white; fruit glossy black, slightly viscid). NORTHEASTERN NEW GUINEA: Sattelberg, *Clemens 1946,* March 1936, alt. ± 900 m. SOLOMON ISLANDS:

Bougainville Island: Kugumaru, Buin, *Kajewski 1844,* June 1930, alt. 150 m., rain-forest (large tree up to 20 m. high; fruits black, 5 mm. long, 3 mm. diameter, in numerous spreading panicles). Guadalcanal Island: Ululolo, near Tutuve Mountain, *Kajewski 2494,* April 1931, alt. 1200 m., rain-forest (a large tree of the higher altitudes, up to 20 m. high, with spreading crown and short trunk; bark grey-brown, with small irregular furrows; sap milky; flowers white, faintly scented). N'Gela Island (Florida Island): northern end of island, *Brass 3504,* January 1933, alt. 100 m., rain-forest slopes (handsome tree with spreading crown; bark pale grey, brittle, slightly suberose, pink when cut; latex copious; flowers white). San Cristobal Island: Waumamura, *Brass 2845,* September 1932, lowland rain-forests (spreading tree 25 m. high; bark grey, peeling in thin flakes; sap milky; flowers white).

In addition to the above material from Papuasia, we have at hand an isotype of *Rhus Engleriana* Warb. from the Key Islands, a collection from Java, one from the Celebes, four from the Philippine Islands, one from Queensland, one from the New Hebrides, two from Tahiti, and four from Samoa. These, we believe, represent a single wide-ranging species. The collections differ chiefly in the amount of pubescence on the lower surface of the leaves; this is so variable in quantity that it does not seem as if it could be a character of any great value. Lauterbach, Bot. Jahrb. **56:** 363. 1920, in his comment on *β. Blumei* Engl. points out that the specimens from New Guinea are glabrous; nevertheless, *Melanococca tomentosa* Blume, Mus. Bot. Lugd.-Bat. **1:** 236. 1850, the basis of *Rhus retusa β Blumei* Engl., is described as subochraceous-tomentose on the branches, petioles, rhachis of leaves, and peduncles. From the collections at hand, we infer that the pubescence of the leaves is a more or less transitory feature. The species passed for a time as *Rhus rufa* Teysm. & Binn., but, following Engler, later workers took up *R. retusa,* apparently a manuscript-name of Zollinger. As far as we know, *R. rufa* Teysm. & Binn. is the earlier published name of the two; but, since the material does not appear to be separable from the Polynesian collections representing *R. taitensis* Guillem., there is no question of priority of names.

Semecarpus Linnaeus f.

Semecarpus magnifica K. Schum. Fl. Kais. Wilhelmsl. 65. 1889; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 411. 1900; Lauterb. Nov. Guin. **8:** 299. 1910, l.c. **8:** 830. 1912, Bot. Jahrb. **56:** 368, *f. 5.* 1920.

British New Guinea: Fly River, 528 mile Camp, *Brass 6792,* May

1936, alt. 80 m., common in forest undergrowth on flooded river banks as well as on the ridges; Palmer River, 2 miles below Black River Junction, *Brass 7304,* July 1936, alt. 100 m., common in forest undergrowth on flood plains and lower ridges; Central Division, Ononge Road, Dieni, *Brass 3943,* April–May 1933, alt. 500 m., rain-forest; Ihu, Vailala River, *Brass 974,* rain-forest. The field notes are here summarized: small slender usually unbranched tree 5–6 m. tall, with a crown of very large oblanceolate leaves (in one number, two whorls 10 cm. apart); panicles several, scattered along the stem, flowers flat, small, white; numerous brown pubescent fruits. The pubescence is somewhat variable, *Brass 3943* being practically glabrous. Not previously reported from British New Guinea.

Semecarpus fulvo-villosa Lauterb. Bot. Jahrb. **56:** 371. 1920.

BRITISH NEW GUINEA: Palmer River, 2 miles below Black River Junction, *Brass 7271,* July 1936, alt. 100 m., forest undergrowth of lower ridges (sparse slender tree 3–4 m. high; leaves stiff, grey below, flowers cream-colored); Lake Daviumbu, Middle Fly River, *Brass 7461,* August 1936, contact zone of rain- and savanna-forest (tree 14 m. high, with pale brown corky deeply fissured bark exuding quantities of black resin when cut; leaves grey beneath).

In the original description based on the staminate plant, specimens are cited from Netherlands New Guinea, Northeastern New Guinea, and the Bismarck Archipelago. The above cited collections seem to fit this species reasonably well, the first is in flower (♂), the second in fruit. Infructescence axis 29 cm. long; branches 1–7 cm. long; dried drupes compressed, transversely and somewhat obliquely ellipsoid, 2 cm. long, 2.5 cm. broad, slightly keeled, golden brown velutinous, closely and very shallowly sulcate from base to apex, apex a little excentric, not beaked; hypocarp also golden brown velvety, turbinate, 6 mm. long, deeply sulcate when dry.

Semecarpus rostrata Valeton, Bull. Dept. Agric. Ind. Néerl. **10:** 29. 1907, Ic. Bogor. **3:** 151, *t. 259.* 1908, Lauterb. Nov. Guin. **8:** 299. 1910, l. c. **8:** 830. 1912, Bot. Jahrb. **56:** 367. 1920.

BRITISH NEW GUINEA: Fly River, 528 mile Camp, *Brass 6788,* May 1936, alt. 80 m., occasional in forest undergrowth on muddy flood banks of river (shrub 1–1.5 m. high; leaves stiff, pale beneath; inflorescence racemose, terminal; fruit ± 5 cm. long, apical portion yellow, fleshy base green); Ihu, Vailala River, *Brass 963,* February 1926, common in rain-forests (small bush with terminal racemose inflorescence; fruit dull green, with much enlarged fleshy yellow base); Murua River, Gulf Division, *Brass 1334,* March 1926, rain-forests.

There is considerable variation in the leaf-outline; nevertheless, these collections agree fairly well with Valeton's description and plate of *Semecarpus rostrata,* a species previously known from Netherlands New Guinea.

Semecarpus decipiens sp. nov.

Arbor 20 m. alta; ramulis glabris, novellis ± angulatis vel sulcatis, innovationibus pubescentibus; foliis petiolatis petiolo 2–3.5 cm. longo glabro supra canaliculato, glabris, coriaceis, utrinque manifeste reticulatis, obovatis vel ellipticis vel lanceolatis, 11–23 cm. longis, 5–9 cm. latis, basi cuneatis atque breviter decurrentibus, apice abrupte ac plerumque anguste acuminatis, margine integris vix revolutis; venis primariis utrinsecus 14–18, supra manifestis, subtus prominentibus, late patenti-adscendentibus prope marginem curvatis ac ± anastomosantibus; paniculis terminalibus axillaribusque, plerumque quam foliis brevioribus, 10–20 cm. longis, minute pubescentibus, ramis subdivaricatis; floribus sessilibus, ♂ : alabastris 1.5 mm. longis pubescentibus; calycis segmentis 0.5 mm. longis subtriangularibus; petalis late lanceolatis subacutis 2 mm. longis; staminibus 2 mm. longis, antheris subcordatis; ovarii rudimento piloso; ♀ : calycis segmentis parvis; petalis elongato-ovatis acutis 2.5 mm. longis; staminibus quam petalis brevioribus, antheris parvis; disco dense pubescente; ovario depresse globoso dense piloso, stylis 3 divergentibus, stigmate bilobo; drupis lateraliter compressis, oblique ac transverse oblongis, 2 cm. longis, 2.5 cm. latis, apice breviter rostratis, rostra 4 mm. longa, consperse pubescentibus, hypocarpio 6 mm. longo ± turbinato.

British New Guinea: Sturt Island, Lower Fly River, *Brass 8194,* October 1936, flood plain rain-forest (profusely flowering tree attaining 30 m.; bark pale brown; leaves glaucous beneath; sap black; flowers green). Solomon Islands: Bougainville Island: Kugumaru, Buin, *Kajewski 1985,* July 1930, alt. 150 m., common in rain-forest (tree up to 20 m. high), Karngu, Buin, *Kajewski 2252,* October 1930, alt. 50 m., common in rain-forest (tree up to 30 m. high). Guadalcanal Island: Uulolo, Tutuve Mountain, *Kajewski 2560,* April 1931, alt. 1200 m. (small tree up to 15 m. high; fruit green with hooked point at end, 2.5 cm. long, 2.6 cm. diameter. The sap of this tree is very caustic, burning the skin severely). San Cristobal Island: Waimamura, *Brass 2666* (type), August 1932, common in coastal rain-forests (erect tree 20 m. tall; bark brown, lenticellate; leaves pale, stiff, slightly wrinkled, glaucous below; flowers white). Malaita Island: Quoimonapu, *Kajewski 2328,* December 1930,

alt. 50 m., rain-forest, common (medium sized tree up to 20 m. high; sap very caustic; flowers minute, petals cream-colored). Ysabel Island: Meringue, *Brass 3167*, November 1932, littoral rain-forest (large spreading tree with pale brown flaky bark; leaves very dull, grey beneath; flowers white); Garona, *Brass 3358*, December 1932, lowland rain-forests, common (tree 10 m. tall; bark pale brown, slightly scaly; leaves stiff, dull green, grey beneath; flowers pale yellow; fruit green; sap mucilaginous).

This species is closely allied to *Semecarpus laxiflora* K. Schum. and *S. uncata* Slis, but these have terminal inflorescences and somewhat different fruits. The fruits of *S. laxiflora* K. Schum. are described as subtomentose with golden hairs, and that of *S. uncata* Slis is pictured with a longer more curving beak than is found in the Solomon Island material.

Semecarpus brachystachys sp. nov.

Arbor 25 m. alta; foliis chartaceis vel tenuiter coriaceis, petiolatis petiolo circiter 3 cm. longo minute pubescente, ellipticis, ad tertium superum paullo latioribus, 25–34 cm. longis, 12–15 cm. latis, basi rotundato-cuneatis vel breviter obtusis, apice rotundatis vel obtusis deinde abrupte acuminatis, margine integris undulatis leviter revolutis, supra glabris vel conspersissime et minute substellatis, crebre reticulatis, subtus glaucis, praecipue costa venisque minute pubescentibus (trichomatibus simplicibus atque substellatis); venis primariis utrinsecus circiter 22 ± parallelis patentibus prope marginem subabrupte arcuatim anastomosantibus, supra manifestis, subtus prominulis, secundariis a primariis fere angulo recto abeuntibus, utrinque manifestis; paniculis terminalibus, in fructu circiter 10 cm. longis, ramis ± pubescentibus; floribus non visis; drupis immaturis lateraliter compressis oblique obovatis, breviter rostellatis rostro excentrico, circiter 4 cm. longis, in parte latissima 3 cm. latis, minute substellato-pubescentibus, brunnescentibus, in sicco longitudinaliter sulcatis; hypocarpio obtuse obconico, circiter 1 cm. longo, 1.2 cm. lato.

SOLOMON ISLANDS: San Cristobal: Magoha River, *Brass 2740* (TYPE), August 1932, river bank, common in lowlands (tree 25 m. tall with brown suberose slightly flaky bark; leaves dull green, grey beneath; fruit immature; sap turns black upon exposure to air).

The leaves somewhat resemble *Semecarpus Anacardium* L., but the inflorescence is much shorter and the fruit much larger. Perhaps among New Guinean species it approaches *S. hirtiflora* Ridley, the latter, however, has hirsute pubescence, a very short inflorescence and fruit about half the size of that of *S. solomonensis*.

Semecarpus Archboldiana sp. nov.

Arbor 21 m. alta; innovationibus pubescentibus; foliis ± rigide coriaceis, utrinque reticulatis, petiolatis petiolo ± 2.5 cm. longo basim versus ± applanato, pubescente, obovato-ellipticis, 9–23 cm. longis, 4.5–11.5 cm. latis, basi late obtusis interdum subrotundatis, apice rotundatis deinde abrupte breviterque acuminatis, margine integris subundulatis, supra glabris interdum costa parce pubescente, subtus flavescentibus glaucis, secus costa venisque ± pilosis; venis primariis utrinsecus 15–23 ± parallelis patentibus, prope marginem arcuatim anastomosantibus, supra impressis, subtus prominentibus, secundariis a primariis fere angulo recto abeuntibus, subtus conspicuis; paniculis ♀ terminalibus ± 16 cm. longis, interdum a basi ramosis, axi crasso ramisque brevissime tomentosis; floribus non visis, breviter pedicellatis vel sessilibus; drupis 1.5–2 cm. longis, 3–5 cm. latis, 3 cm. crassis, apice profunde depressis, sublobatis, uno latere subcarinatis, ± minute tomentosis, hypocarpio obtuse obconico, 1 cm. longo, 2 cm. lato, longitudinaliter subsulcato, minute tomentoso.

Netherlands New Guinea: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 12590* (type), February 1939, alt. 1230 m., rare in primary rain-forest on ridge (tree 21 m. high, 42 cm. diameter; bark 15 mm. thick, scaly, black, with some black sap; fruits green).

The alliance of this species is unquestionably with those Philippine and Polynesian species, *S. philippinensis* Engl. and *S. vitiensis* Engl., at one time placed in *Oncocarpus* A. Gray. Although the depressed and somewhat knobby sinuate drupes are readily distinguishable from the laterally compressed ones of *Semecarpus* L. f. proper, nevertheless, from the available material examined, we are inclined to agree that the two are not separable on strong generic characters, but might well represent distinct sections. Probably *S. venenosa* Volkens of Micronesia belongs to this same group.

CORYNOCARPACEAE

Corynocarpus J. R. & G. Forster

Corynocarpus australasica C. T. White, Contr. Arnold Arb. **4**: 57, *pl. 5*. 1933; Van Steenis, Bull. Jard. Bot. Buitenz. III. **13**: 101 *f. 1*. 1933.

Netherlands New Guinea: 6 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13101*, March 1939, alt. 1220 m., rare tree in primary forest (bark black, scaly, rough; wood yellow-

brown). BRITISH NEW GUINEA: Lake Daviumbu, Middle Fly River, *Brass 7713*, September 1936, rain-forest substage (tree 12 m. high; leaf-nerves prominent below; immature fruit smooth, globose, ± 4 cm. diameter).

The species is known from three previous collections, two from Queensland, and one from Netherlands New Guinea (southern part) cultivated in the Botanic Gardens at Buitenzorg. This material seems to match the type fairly well as to foliar characters and fruit, the floral parts have practically all fallen. Professor I. W. Bailey and Mr. Richard Howard very kindly sectioned twigs for us and compared the structure of the wood with that of prepared material of *Corynocarpus*.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

OBSERVATIONS ON OLD WORLD SPECIES OF TURPINIA VENTENAT

E. D. Merrill and L. M. Perry

Since we have found no records of the occurrence of species of *Turpinia* Vent. in Papuasia, we were obliged to begin with the Indo-Malaysian collections as a starting point in the identification of the nine New Guinean numbers at hand. The species are readily separated into two categories, one with simple leaves, the other with compound ones. The first, consisting of *T. arguta* Seem. with much larger flowers than the other species, *T. formosana* Nakai, *T. indochinensis* Merr., *T. simplicifolia* Merr., and *T. unifoliata* Merr. & Chun, has received no consideration, as all our strictly simple-leaved specimens have been named. Approximately 20 binomials have been proposed for the compound-leaved species. A few have been credited with a wide geographical range, while others are as yet restricted to limited areas. In addition to considerable unnamed material in the herbarium, there is so much variation in the named collections that it has seemed necessary to try to find some stable specific characters. This has been no easy task. Species are difficult to delimit, some currently recognized ones at times passing almost imperceptibly into closely related forms. Craib, Fl. Siam. Enum. **1**: 339. 1926, commenting on his *T. parviflora*, said "this species, *T. parva*, and *T. nepalensis* are very closely allied and require further study in the field." Probably the only satisfactory study of the genus lies in the correlative observation of living and herbarium material. This, of course, is out of the question for us; further, we are handicapped by the lack of types. Nevertheless, we venture to set forth a summary of the compound-leaved species in the hope that it may be useful to others because of the widely scattered literature appertaining to the genus.

In the Indo-Malaysian material the stipels of the leaflets are separate. In the collections from New Guinea, the two stipels of the pairs of opposite leaflets are united into one and bent backward toward the proximal end of the leaf in such a way as to cover at the point of insertion the shallow channel of the rachis lying between the insertion of the leaflets. As to the other foliar characters, differences are evident in the leaf-texture, and also in the relatively even or obviously uneven

distribution of the primary nerves along the midribs. Again, in some species, the margins are more definitely serrulate or crenulate-serrulate than in others. Although the leaf-outline is highly variable, if one has an abundance of material there are certain definite trends which tend to mark a species; for instance, in *T. pomifera* (Roxb.) DC. there is a distinct tendency toward an elongated apex which is rarely found in our material of *T. sphaerocarpa* Hassk. We have not found the number of leaflets a dependable character, nor seen any strictly trifoliolate species. Our specimens are 1–3–5-foliolate or 5–7–11-foliolate. Craib, in describing *T. robusta,* points out that one leaf is 4-foliolate in the type-specimen. We have no material either of this species or of the related *T. trifoliata* Ridl. from the Malay Peninsula. The latter ought to be easy to recognize by the short panicle; as for the foliar characters of Ridley's species, it should be noted that in the original description, Jour. Roy. As. Soc. Straits Branch **82**: 178. 1920, the petioles are described as ".2 in. long," which is repeated in Ridley's Fl. Malay Pen. **1**: 512. 1922, but *fig. 50* of the latter work shows them to be longer than any of the petiolules; the sketch is probably correct. The relative length of the panicle, its laxness, and the arrangement of the flowers, whether crowded or not, are fairly useful specific characters. The flowers are almost too constant to be of much help in determinative work. In some species the petals are ciliolate, some have larger anthers, a few have pubescent filaments, and the number of ovules varies, as from 2–4, 4–6, and 6–8. The size of the fruit would seem to be a fairly good character, but it is difficult to evaluate in the herbarium on account of the collections being in various stages of development. The thickness of the pericarp appears to be of some value, since, even in immature fruits of the fleshy-fruited species, this feature is foreshadowed by the relatively small locules in comparison with the thickness of the pericarp and the size of the fruit. Pubescence is a minor feature of *Turpinia* Vent. In two collections from Sumatra the leaflets are pubescent on the lower surface. *T. malabarica* Gamble, *T. ternata* Nakai, and sometimes *T. affinis* have pubescent or ciliolate filaments. *T. affinis* is the only species we have found with the style and the upper part of the ovary hirtellous.

Although the genus extends from China to New Guinea, several species have a limited distribution. The one with widest range, China, Indo-China, Sumatra, and Java, appears to be *Turpinia montana* (Blume) Kurz, with a variety in Borneo. *T. pomifera* (Roxb.) DC. has been considered a collective species extending from India to the Celebes, but our specimens indicate that *T. pomifera* (Roxb.) DC. in the strict

sense is found in northern India (including Assam and Burma), Siam, Indo-China, and western China. *Turpinia sphaerocarpa* occurs in Sumatra, Java, Borneo, Mindanao, and the Celebes.

Omitted from our summary is the consideration of *T. parviflora* Craib, *T. robusta* Craib, and *T. trifoliata* Ridl. We have no material so labelled, and none from the region of the type-localities that seems to fit their descriptions. Even when we have specimens to examine, the characters are sometimes so elusive that we cannot always be sure of the proper disposition of the collections. Our superficial key represents such species as are available to us in the herbarium material at hand. We are citing only what we take to be representative specimens, although in some cases we have numerous collections of individual species.

KEY TO SPECIES

1. Stipels separate. Indo-Malaysia.
   2. Pericarp somewhat fleshy, 1–5 mm. or more thick in the dried fruit.
      3. Fruit 2–2.5 cm. diameter; pericarp 2–5 mm. or more thick; half-open flowers 3.5–4 mm. long, anthers oblong-ovate, 0.8–1 mm. long; leaves oblong-elliptic, often elongate-acuminate ..... *T. pomifera* (Roxb.) DC.
      3. Fruit up to 2 cm. diameter; pericarp 1–2(–3 in larger fruits) mm. thick; half-open flowers 2–3 mm. long, anthers ± round, 0.6–0.8 mm. diameter; leaves oblong or elliptic, rarely elongate-acuminate.
         4. Filaments pubescent ..... *T. malabarica* Gamble.
         4. Filaments glabrous.
            5. Primary veins of leaflets 7–9, equally distributed along either side of the midrib; margins of leaflets distinctly crenulate-serrulate or serrulate.
               6. Leaves oblong, thinly coriaceous .... *T. sambucifolia* Elmer.
               6. Leaves elliptic or oblong-ovate, coriaceous .... *T. sphaerocarpa* Hassk.
            5. Primary veins of leaflets 4–6, gradually more remote toward the distal end of the leaflets; margins of leaflets usually indistinctly crenulate or serrulate.
               6. Inflorescence lax, loosely flowered; fruit depressed between the remnants of the subconic bases of the styles ..... *T. latifolia* Ridl.
               6. Inflorescence more compact and stiff; fruit ± rounded or subtrilobed at the apex ... *T. ovalifolia* Elmer.
   2. Pericarp scarcely fleshy, 0.5–1 mm. thick, often wrinkled when dry.
      3. Half-open flowers relatively large, about 3 mm. long, anthers elliptic, 0.8–1 mm. long.
         4. Pistil glabrous.

5. Filaments glabrous; leaflets rather stiffly coriaceous, closely crenulate-serrulate; venation prominent; primary veins spreading, then arcuate, ascending for some distance almost parallel with the margin .... *T. nitida* M. & P.

5. Filaments pubescent; leaflets thinly coriaceous, remotely crenulate; venation not prominent; primary veins spreading-ascending, toward the margin arcuate ... . *T. ternata* Nakai.

4. Pistil, at least the style and exposed part of the ovary, sparsely hirtellous ..... *T. affinis* M. & P.

3. Half-open flowers relatively small, 2–2.5 mm. long, anthers ± round, 0.5–0.6 mm. diameter or a little broader than long.

4. Inflorescence compact, somewhat stiff; flowers crowded.

5. Leaves coriaceous; secondary venation inconspicuous ... . *T. cochinchinensis* (Lour.) Merr.

5. Leaves chartaceous to subcoriaceous; secondary venation somewhat conspicuous ..... *T. glaberrima* Merr.

4. Inflorescence lax, usually longer than the leaves; flowers scarcely crowded.

5. Leaflets chartaceous; secondary venation easily seen .... *T. montana* (Bl.) Kurz.

5. Leaflets thinly coriaceous; secondary venation inconspicuous ..... *T. laxiflora* Ridl.

1. Stipels united into one intrapetiolular stipel and recurved toward the proximal end of the leaf. New Guinea.

2. Leaflets ovate-elliptic, rounded at the base, inconspicuously serrulate; fruit subglobose, marked at the apex with 3 radiating lines; ovules in each locule 6–8 ..... *T. Versteeghii* M. & P.

2. Leaflets mostly oblong, obtuse at the base, serrulate; fruits 3-pointed at the apex; ovules in each locule 2. . *T. papuana* M. & P.

Turpinia pomifera (Roxb.) DC. Prodr. **2**: 3. 1825.

Dalrymplea pomifera Roxb. Pl. Coromand. **3**: 76, *t. 279.* 1819.

INDIA: Jalpaiguri, *Parker 3217;* Sikkim, *J. D. Hooker,* alt. 2–7000 ft.; Khasia, *Hooker f. & Thomson,* 2–5000 ft.; Assam, Margarata, *Dr. Prain's collector 986, 994.* BURMA: Moulmein, *Falconer;* Pegu, *Kurz 2050;* Mergui, *Parker 3083, 3172.* SIAM: Chiengmai Province, *Rock 1841, 1904.* INDO-CHINA: Tonkin, vicinity of Dong Mo, *Pételot 6320.* CHINA: Yunnan: Szemao, *Henry 11612F;* valley of the Nam Ha, *Rock 2490, 2505;* near Chieng Law, *Rock 2367;* Meng-bang, Jenn-yeh Hsien, *Wang 80302;* Tsang Yuan, *Wang 73219;* Che-li-Hsien, *Wang 75946, 77674, 77574, 79334.*

The strongest characters of this species appear to be the elliptic-

oblong acuminate leaflets (up to 23 cm. long and 8 cm. broad), the panicle usually shorter than the leaves, the fairly large flowers (half-open flower about 3.5–4 mm. diameter) crowded towards the tips of the ultimate branchlets, the ovate-oblong anthers 0.8–1 mm. long, and the fleshy fruits (in our dried specimens ± 2 cm. diameter). Roxburgh described the fruit as "the size of a large medlar." None of the other species of the genus in the herbarium material available to us has as fleshy fruits as this. Further, it can usually be distinguished, even if immature, by the small locules and the relatively thick pericarp.

Turpinia malabarica Gamble, Kew Bull. **1916:** 135. 1916; Alston, Handb. Fl. Ceyl. **6**(Suppl.): 59. 1931.

INDIA: Concan, *Stocks & Law.* CEYLON: *Thwaites 218.*

Our material of this species is not in very good condition; but apparently the two best characters of this species are the pubescent filaments and the size of the fruit (about 1.3 cm. diameter). The pericarp is a little fleshy, not nearly so thick as in *T. pomifera* DC., but thicker than that of *T. cochinchinensis* (Lour.) Merr.

Turpinia sambucifolia Elmer, Leafl. Philip. Bot. **9:** 3217. 1934.

PHILIPPINE ISLANDS: Luzon, *Elmer 8750, 22178* (ISOTYPE); *Loher 14941; Merrill 2502; Williams 551; Vanoverbergh 1088; Forestry Bureau 24951* (*Amarillas*), *29362* (*Azurin*); *Bureau of Science 24252* (*Ramos*).

This species is very like *Turpinia sphaerocarpa* Hassk. The leaves are somewhat thinner in texture and oblong rather than elliptic. These are the only differences we see at present. Since we did not find any collection from Luzon exactly matching *T. sphaerocarpa* Hassk., we are maintaining the species for the present.

Turpinia sphaerocarpa Hassk. Flora **25:** Beibl. 42. 1825.

Dalrymplea javanica Hassk. Pl. Jav. Rar. 439. 1848.

Turpinia pomifera sensu Koord. & Valeton, Meded. Lands Plant. **61:** 245 (Bijdr. Boomsoort. Java **9:** 245). 1903, Atlas Baumart. Java **1:** *fig. 93.* 1913, non DC.

JAVA: *Forbes 951, 965, 973; Kuntze 5909; Netherlands Indies Forest Service Ja.3076, Ja.3145, Ja.3734.* SUMATRA: *Forbes 2480, W. N. & C. M. Bangham 862, 981.* BORNEO: Mount Kinabalu, *Clemens 10407, 34388, 34423, 34462, 40321, 51675.* PHILIPPINE ISLANDS: Mindanao, Province of Davao, *Elmer 11726, 11825;* Province of Surigao, *Forestry Bureau 26983.* CELEBES: *Netherlands Indies Forest Service Cel./ II–238.*

We regret that we have not better material from Java representing

this species, as these are the logical collections to use as a basis of this specific concept. Only *Kuntze 5909* (a specimen borrowed from the New York Botanical Garden) has flower buds sufficiently well developed to show the parts of the flower fairly well; from this and *fig. 93* of Atlas Baumart. Java, we have taken the measurements for the anthers. In the Bornean material, particularly *Clemens 40321*, the apex of the anthers is much more distinctly apiculate; however, in view of the somewhat fragmentary material and the similarity in foliar characters, we have placed the Bornean collections in this species. *Clemens 40321* differs also in having somewhat narrower, almost ligulate, petals.

Turpinia sphaerocarpa Hassk. somewhat resembles *T. pomifera* (Roxb.) DC., but the leaflets as a whole are smaller, with finer crenulate-serrulate margins, and usually with a shorter apex (acumen up to 1.5 cm. long; unfortunately the tips of the leaflets are mutilated in many of our specimens; in *T. pomifera* DC. the acumen is 1–3 cm. long, usually about 2 cm.); the inflorescence is more ample, with less crowded and smaller flowers (half-open flower 2 mm. diameter), the anthers are rounded and only 0.5–0.6 mm. long, and the dried fruit rarely exceeds 1.5 cm. diameter.

Turpinia latifolia Ridl. Jour. Roy. As. Soc. Straits Branch **82**: 178. 1920, Fl. Malay Pen. **1**: 512. 1922.

MALAY PENINSULA: Singapore, *Corner 34688, Ngadiman 34690;* Johore, *Corner 28690, 28710.* SUMATRA: vicinity of Rantau Parapat, Bila, *Rahmat Si Toroes 1916, 1924, 2254;* Division Padang Si Dimpoean, *Rahmat Si Toroes 4808, 4886, 4921.*

This species, in the lax inflorescences, the size of the flowers, and the small anthers, is very like *Turpinia sphaerocarpa* Hassk. The leaflets, however, have a smaller number of primary veins, and these are obviously farther apart and unevenly distributed along the midrib, the interval between the adjacent pairs becoming longer toward the distal end of the leaflet; the margins too are only indistinctly crenulate-serrulate. The specimens from the Malay Peninsula are only in flower. In the Flora of the Malay Peninsula, l.c., Ridley described the fruit as "globose fleshy green .5 in. through." In the Sumatran collections, the apex of the fruit, even in some as large as 2 cm. diameter, is depressed between the remnants of the laterally compressed subconic bases of the styles.

Turpinia latifolia Ridl. var. **pubescens** var. nov.

A forma typica differt ramulis, petiolo ac rhachi pubescentibus; foliolis supra glabris, subtus praecipue costa nervisque pubescentibus; inflorescentiae axi, ramis ramulisque ± pubescentibus.

SUMATRA: Sigamata, near Rantau Parapat, Bila, *Rahmat Si Toroes 2922* (TYPE); Padang Si Dimpoean, Goenoeng Manaoen, *Rahmat Si Toroes 4468*.

The type is fragmentary, the leaflets being mostly separated from the rachis, but the flowers are normal. In the other specimen, the leaves are 3- and 5-foliolate, but all the flowers seem to have been stung. The general habit of the collections is much like that of *Turpinia latifolia* Ridl., hence, we have allied the material with that species. These are the only specimens of the genus in which we have seen pubescence on the leaves.

Turpinia ovalifolia Elmer, Leafl. Philip. Bot. 2: 490. 1908.

Turpinia lucida Nakai, Jour. Arnold Arb. 5: 80. 1924.
Turpinia pachyphylla Merr. Philip. Jour. Sci. 27: 33. 1925.

PHILIPPINE ISLANDS: Luzon, *Elmer 8088* (isotype), *8601; Bureau of Science 22559* (*Ramos & Deroy*), *22585* (type of *T. lucida* Nakai), *40243* (*Ramos & Edaño*), *41483* (*Ramos*), *45283* (*Ramos & Edaño*); *Forestry Bureau 22703* (*Gangan*), *24294* (*Bawan & Borromeo*); *Adduru 273;* Palawan, *Elmer 13122*.

This species and *Turpinia latifolia* Ridl., apart from their geographical range, are difficult to distinguish. In the Philippine material, the inflorescence is usually shorter than the leaves and also not so open as in *T. latifolia* Ridl., and the flowers are a little larger (half-open bud 3 mm. long) and of firmer texture than in the Malayan plant.

Turpinia nitida sp. nov.

Arbuscula glabra, tantum inflorescentia minute pubescens; petiolo ± 6 cm. longo, rhachi 10 cm. longa; foliis 1–2-jugis; foliolis valde coriaceis, oblongis vel ellipticis, 10–20 cm. longis, 4–9 cm. latis, basi rotundatis interdum leviter inaequalibus, apice breviter acuminatis, marginibus dense serratis, utrinque nitidis, manifeste reticulatis; venis primariis utrinsecus ± 10 patulis deinde arcuatim adscendentibus, versus marginem inconspicue vel haud anastomosantibus; petiolulis 1–3 cm. longis; paniculis 17 cm. longis, ramis 4 cm. longis atque ramulis puberulis; pedicellis ± 2 mm. longis; floribus sub anthesi 4.5 mm. diametro; sepalis 3–4 mm. longis late ellipticis rotundatis ciliatis; petalis oblongis 4 mm. longis vix ciliolatis; filamentis circiter 3.5 mm. longis, basi 0.8 mm. latis, apice subulatis, antheris ovatis circiter 1 mm. longis, apice apiculatis (apiculo 0.2 mm. longo); disco crenulato ovario glabro subaequilongo; stylis glabris ± connatis; ovulis 4 in loculo; baccis immaturis ± 1 cm. diametro, stylorum basibus persistentibus; pericarpio 0.5 mm. crasso.

BORNEO: Mount Kinabalu, Penibukan, *Clemens 30770* in part, *30840* (TYPE), January 1933, alt. 4000–5000 ft. (recumbent treelet; fruit purplish); Marai Parai, *Clemens 30178*, May 1933, alt. 3000 ft. (flowers cream-green, corolla purple on the margin).

This species is perhaps closest to *Turpinia sphaerocarpa* Hassk. The leaflets, however, are more regularly coriaceous than in the latter species, the flowers are somewhat larger with anthers almost 1 mm. long and very distinctly apiculate, and the fruits, with a pericarp 0.5 mm. thick, could scarcely be called fleshy.

Turpinia ternata Nakai, Jour. Arnold Arb. **5:** 78. 1924.

JAPAN: Liukiu, *Yokohama Nursery Company; C. Wright;* Kyushu, *Tashiro* (TYPE); *E. H. Wilson 6107.* FORMOSA: *E. H. Wilson 11072.*

In these collections the leaves are 1- and 3-foliolate. This is the nearest approach to a trifoliolate species in our herbarium. *Turpinia ternata* Nakai is a fairly well marked species with half-open flowers 3–4 mm. diameter, pubescent filaments and large ovate-oblong anthers 0.8 mm. long; the fruits are immature, but in these the pericarp is scarcely more than 0.5 mm. thick.

Turpinia affinis sp. nov.

Arbor parva ubique praeter inflorescentiam glabra; cortice fusco; petiolo 6–14 cm. longo, rhachi 9–25 cm. longa; foliis impari-pinnatis 2–4(interdum–5)-jugis; stipulis caducis, stipellis minutis; foliolis elliptico-oblongis, 7–18 cm. longis, 2.5–6 cm. latis, basi cuneatis vel obtusis, apice acuminatis (acumine 1–2.5 cm. longis), margine plerumque dense serratis, coriaceis, inconspicue reticulatis; venis primariis utrinsecus 7–10 arcuatim adscendentibus; petiolulis 1–1.5 cm. longis; paniculis usque 30 cm. longis, divaricatim ramosis, axi ramulisque minute pubescentibus; floribus in ramulis ultimis pseudoracemosis vel cymoso-confertis, magnis; pedicellis ± 1.5 mm. longis; sepalis elliptico-ovatis obtusis ciliatis 2.5–3 mm. longis; petalis 4 mm. longis obovato-ellipticis ciliatis, interdum paullo pilosis; filamentis 3 mm. longis, basi 1 mm. latis sursum angustatis, saepe ciliolatis, antheris ovato-oblongis 1(–1.2) mm. longis; disco dentato ½ longitudinem ovarii; ovario 1 mm. longo, parte superiore atque stylis (2 mm. longis) ± parce hirtellis; ovulis 6–8; baccis subglobosis, 1–1.5 cm. diametro, cicatricibus stylorum persistentibus, plerumque parce hirtellis; pericarpio 0.5–1 mm. crasso.

CHINA: Hupeh, *Chow 2004;* Kweichow, *Steward, Chiao & Cheo 768;* Kwangsi, *Steward & Cheo 380; Tsang 22365, Chun 6817;* Szechuan, *Wilson 2351, 3359, 4803; Fang 3797, 12574; Chiao & Fan*

136; Yu-Shih Liu 1283, 1885; Yunnan, *Tsai 53322, 54334, 54598, 55334, 55982, 56614, 58519, 58667, 59122; Yü 17774, 19949; Forrest 15683* (TYPE), *17583, 18075, 26224, 26272; Henry 10694;* Sikong, *Chiao 1286, 1704.* INDO-CHINA, Tonkin, Chapa, *Pételot 5929.*

Data on the type number, *Forrest 15683,* taken from Notes, Roy. Bot. Gard. Edinburgh **17**: 152. 1930: "Shrub or tree of 30 or 40 ft. Flowers creamy-white. In open thickets on the Shweli-Salween divide. Lat. 25°30′ N. Alt. 10,000 ft. July 1917." This species has flowers as large as those of *Turpinia pomifera* (Roxb.) DC. The leaflets, although acuminate, have not the elongate apex which marks most of the collections of the latter species. The fruits are scarcely at all fleshy and not nearly so large as in *T. pomifera* (Roxb.) DC. Indeed, it would seem that this species is the explanation of why *T. pomifera* (Roxb.) DC. and *T. cochinchinensis* (Lour.) Merr. (*T. nepalensis* Wight & Arn.) have been confused in China. *Turpinia affinis,* although readily separated from *T. cochinchinensis* (Lour.) Merr. in the flowering state by the open lax inflorescence with flowers almost twice as large, is somewhat difficult to distinguish in the more nearly mature fruits. In all the specimens cited we have been able to see, around the subpersistent bases of the styles, some remnants of the pubescence which is readily seen on the pistil in the flower. The leaves usually have 5–9, sometimes 11, leaflets, a little broader than in the related species and more closely serrate.

Turpinia cochinchinensis (Lour.) Merr. Jour. Arnold Arb. **19**: 43. 1938.

Triceros cochinchinensis Lour. Fl. Cochinch. 184. 1790.
Turpinia nepalensis Wight & Arn. Prodr. 156. 1834.

INDIA: Nepal, *Wallich 4277;* Assam, Khasia, *Hooker f. & Thomson;* Khasia and Jaintia Hills, *Ruse 137.* BURMA: Thandaung, *Dickason 5143;* Kachin Hills, *Shaik Mokim.* INDO-CHINA: Annam, Mt. Bana, *Clemens 3791;* Tonkin, *Petelot 4242.* CHINA: Yunnan, *Henry 11612, A,B,H,I; Tsai 54310, 54504, 54625, 56367, 56400, 56912, 58789, 58887, 58985; Forrest 7476, 8474, 11857, 11888, 15758, 17867, 17893, 26410, 26521; Rock 2924, 7200; Wang 73075, 76313, 77381; Yü 18195.*

Turpinia cochinchinensis (Lour.) Merr. shows considerable variation. Amongst the material cited are specimens with 3-foliolate leaves, 3- and 5-foliolate leaves, but most have 5-foliolate leaves. The species is not an easy one to define. It blends into *T. montana* (Blume) Kurz and *T. glaberrima* Merr. on the one hand, and on the other it is not easy to distinguish from *T. affinis* in fruit. Its best character is the somewhat

stiff compact inflorescence and small flowers. In *T. montana* (Blume) Kurz the netted venation of the leaves is much more distinct, the serrations are closer, and the inflorescence is longer and distinctly lax.

Turpinia glaberrima Merr. Lingnan Sci. Jour. **7**: 312. 1931, l.c. **14**: 27. 1935.

CHINA: Kwangsi, *Ko 55847;* Kwangtung, *Tsiang 1701, 2715; Taam 176, 579;* Hong Kong, *C. Wright;* Hainan, *How 70303, 71654, 73218; Wang 36220, 36510; Liang 63626, 64285, 64286, 64719; Chun & Tso 43958, 43682, 43918, 44396; McClure* (*C.C.C. 8497*). INDO-CHINA: along Kwangtung-Tonkin border, Taai Wong Mo Shan, *Tsang 27226.*

This species needs to be studied in the field; it is perplexingly inconstant. Some numbers have the leaves 1- and 3-foliolate, other 3- and 5-foliolate, or all 5-foliolate, a single number which we interpret as a young growing shoot of this species has 9–11-foliolate leaves. Some specimens are disturbingly close to *Turpinia montana* (Blume) Kurz, yet none has as long an inflorescence as that species; further, although the secondary venation is fairly distinct, the leaves are mostly firmer. Other collections are scarcely separable from *T. cochinchinensis* (Lour.) Merr. since we have removed *T. affinis* from that complex. Possibly more material of the three species will lead to the reduction of this.

Turpinia glaberrima Merr. var. **stenophylla** var. nov.

A forma typica differt foliolis angustioribus 4.5–6(–10) cm. longis, 1.5–2 cm. latis, plerumque rhachi breviore.

CHINA: Kwangtung, along the Kwangtung-Tonkin Border, Fang Ch'eng District, *Tsang 26739* (TYPE); Kwangsi, Sup-man-ta Shan, *Liang 69616, 69632.*

These specimens are all fruiting material. The type of the variety has leaves small enough to belong to *Turpinia parviflora* Craib, described from Siam. We have no material so named, and Craib points out that it is very closely allied both to *T. parva* Koord. & Val. and to *T. nepalensis* Wight & Arn. Both the latter species have a fairly large inflorescence; the inflorescence in both *T. glaberrima* Merr. and var. *stenophylla* is mostly shorter than the leaves.

Turpinia montana (Blume) Kurz, Jour. As. Soc. Bengal **46**(2): 182. 1875; Koord. Exkursionfl. Java **2**: 528. 1912; Koord. & Val. Atlas. Baumart. Java **1**: *fig. 92.* 1913; Merr. Contr. Arnold Arb. **8**: 93. 1934, Jour. Arnold Arb. **19**: 42. 1938.

Zanthoxylum montanum Blume, Bijdr. 248. 1825.

Turpinia parva Koord. & Val. Meded. Lands Plant. **61**: 249 (Bijdr. Boomsoort. Java **9**: 249). 1903.

Turpinia gracilis Nakai, Jour. Arnold Arb. **5**: 79. 1924. For further synonymy, consult Koorders (1912) and Merrill (1934).

CHINA: Yunnan, Szemao, *Henry 12039, b, c;* Fo-Hai, *Wang 73601, 73694, 73813, 74654, 74797, 77154;* Nan-Chiao, *Wang 75050, 75136, 75181;* Che-li Hsien, *Wang 75497, 75693, 78111, 79504, 79713.* INDO-CHINA: Tonkin, *Pételot 5959;* Annam, Mt. Bana, *Clemens 3894;* Cambodia, *Pierre 907.* SUMATRA: on trail from Kabajakan to Tretel, *W. N. & C. M. Bangham 887.* JAVA: *Hallier; Kuntze 4498.*

Turpinia montana (Blume) Kurz appears to be the most widely ranging species of the genus. It is a small tree with very slender and lax panicles as long as, or usually longer than, the leaves; the scarcely crowded flowers are small (half-open bud 2 mm. diameter) with ciliate petals and rounded anthers ± 0.5 mm. long; the fruit is 7-8 mm. diameter. The venation of the chartaceous leaves is perhaps more obvious than in any other known species.

Turpinia montana (Blume) Kurz var. **borneensis** var. nov.

Foliolis usque 14 cm. longis et 5 cm. latis; fructibus usque 1.5 cm. diametro.

BORNEO: Sarawak, *Native collector 2379;* Mount Kinabalu, Penibukan, *Clemens 31369, 31657, 40996,* alt. 4000–8000 ft.; Tenompok, *Clemens 28840, 29391 bis* (TYPE), *29391, 30070,* alt. 5000 ft.

The leaflets, although larger than in *Turpinia montana* (Blume) Kurz, somewhat broader and more rounded-cuneate at the base, are similar in texture and venation to those of the species. In the few inflorescences at our disposal we have not found any floral differences worth noting. The fruit is larger in some cases, but the seeds are few and the pericarp is thin. When more and better prepared material is at hand this may prove to be a distinct species.

Turpinia laxiflora Ridl. Jour. As. Soc. Straits Branch **82**: 179. 1920, Fl. Malay Pen. **1**: 512, 1922.

MALAY PENINSULA: Perak, Larut, *Dr. King's collector 5640* (Chanderiang). SUMATRA: Asahan, *Krukoff 4425; Rahmat Si Boeea 6689, 6871, 6894, 7198;* Simaloer, *Achmad 559.*

The distinguishing features of this species are the long lax panicles and the small (7–10 mm. diameter) dry fruits. In the specimens at hand all the dried fruits are wrinkled. This may be on account of their not

being mature, or because of the thin pericarp (± 0.5 mm. thick). The leaves are very much like those of *Turpinia latifolia* Ridl.

Turpinia Versteeghii sp. nov.

Arbor ± 21 m. alta glabra, tantum inflorescentia minute pubescens; petiolo 6–8 cm. longo, rhachi 5–8 cm. longa; stipulis caducis; foliis 1–3-jugis; stipellis in stipellam unam intrapetiolularem recurvatim connatis; foliolis coriaceis ovatis vel ellipticis, 9–17 cm. longis, 4.5–8.5 cm. latis, basi subrotundatis vel leviter cuneatis, apice breviter acuminatis, acumine ± 1 cm. longo, margine inconspicue serrulatis interdum revolutis, subnitidis; venis primariis utrinsecus 8, utrinque manifestis, patulis deinde curvatim adscendentibus; reticulo subobscuro; petiolulis 1–1.5 cm. longis, terminali 2–4 cm. longo; paniculis ad maturitatem 20–30 cm. longis, ramis subadscendentibus; floribus 3–4 mm. diametro; sepalis oblongis rotundatis ciliatis; petalis obovato-oblongis ciliatis; filamentis 2.5 mm. longis, basi 0.6–0.8 mm. latis, apice subulatis; antheris ellipticoovatis 0.8 mm. longis minute apiculatis; disco dentato; ovario glabro; stylis glabris; ovulis in loculo 6–8; baccis obsolete trilobis 1.5 cm. diametro; pericarpio 2 mm. crasso.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, *Brass & Versteegh 13586* (TYPE), April 1939, alt. 300 m., frequent in primary rain-forest (tree 21 m. high, 39 cm. diameter; bark grey-brown, scaly, fissured; fruit green); 2 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 13532*, April 1939, alt. 700 m., frequent in primary rain-forest (tree 26 m. high, 50 cm. diameter; fruit green). NORTHEASTERN NEW GUINEA: Sattelberg, *Clemens 3089*, May 1936, alt. ± 1000 m. (flowers white).

The species is marked by the large and inconspicuously serrulate leaflets; the fruit lacks the protruding base of the styles so well marked in the other New Guinean species. Probably *Clemens 3358* and *4041* from Yunzaing also belong here. Both are fragmentary specimens.

Turpinia papuana sp. nov.

Arbor ± 20 m. alta praeter inflorescentiam puberulam glabra; petiolo 3–6 cm. longo, rhachi 2–5 cm. longa; foliis 1–2-jugis (in una collectione 1–5-foliolatis); stipulis caducis; stipellis in stipellam unam intrapetiolularem recurvatim connatis; foliolis coriaceis oblongis vel ellipticis, 7–11(–15) cm. longis, 2.7–4(–7) cm. latis, basi obtusis, apice acuminatis, acumine 1–2 cm. longo, margine serrulatis; venis primariis utrinsecus circiter 8 patulo-adscendentibus, reticulo inconspicuo; inflorescentiis in fructu usque 18 cm. longis, juvenilibus ad nodos multibracteatis,

bracteis minute foliiformibus; baccis subglobosis vel subtrilobis, 1.5 cm. diametro, apice remote 3-tuberculatis; ovulis 1–2 in uno loculo; pericarpio 2–2.5 mm. crasso.

NETHERLANDS NEW GUINEA: 18 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11994* (TYPE), February 1939, alt. 2160 m., frequent tree of the primary forest, on the slope of a ridge (tree 20 m. high, 37 cm. diameter; bark grey; fruit green); 15 km. southwest of Bernhard Camp, Idenburg River, *Brass & Versteegh 11960,* January 1939, alt. 1750 m., occasional tree in primary forest, on ridge (tree 17 m. high, 36 cm. diameter; bark grey; fruits brown); Bele River, 18 km. northeast of Lake Habbema, *Brass & Versteegh 11143,* November 1938, alt. ± 2400 m., occasional in primary forest (tree 17 m. high; 33 cm. diameter; bark grey; fruits green-brown). NORTHEASTERN NEW GUINEA: Ogeramnang, *Clemens 6405,* May 1937, alt. ± 1750 m.

Although we are handicapped by the lack of flowers, this material seems to be relatively uniform, differing from *Turpinia Versteeghii* in the smaller leaves with less rounded bases and definitely serrulate margins. The fruits are 3-pointed at the apex and in each locule are only 1–2 ovules. In *T. Versteeghii* there are 6–8 ovules in each locule.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

THE COMPARATIVE MORPHOLOGY OF THE ICACINACEAE
IV. RAYS OF THE SECONDARY XYLEM

I. W. BAILEY AND R. A. HOWARD

With four plates

INTRODUCTION

WE have shown in the preceding papers of this series that a segregation of the Icacinoideae into three categories, upon the basis of their nodal anatomy and vessel structure, serves to differentiate their imperforate tracheary elements and wood parenchyma into three general levels of increasing structural specialization. It is of interest in this connection to determine whether the salient trends of phylogenetic modification of the rays tend to parallel those that occur in the other elements of the secondary xylem.

Kribs' (6) statistical investigations of the wood of large stems indicate that the primitive ray structure in dicotyledons is of the so-called heterogeneous I type. Woods with this primitive structure are characterized by having two types of rays, (1) vertically extensive, high-celled, uniseriate rays and (2) multiseriate rays with relatively long, high-celled, uniseriate extensions. Barghoorn's (4) recent detailed studies of ray ontogeny in the various families of the dicotyledons demonstrate that in structurally less modified plants both the first-formed and the later-formed secondary xylem have rays of the heterogeneous I type. In young stems, the first-formed multiseriate rays extend outward from the gaps or interfascicular parts of the stele, whereas in young roots they arise opposite the strands of primary xylem rather than between them. The first-formed uniseriate rays of young stems extend outward from the fascicular parts of the stele.

The original uniseriate and multiseriate rays are very extensive vertically, but are dissected into lower rays during subsequent stages of the lateral enlargement of the stem. During these stages of ontogeny, the multiseriate rays commonly undergo a more or less conspicuous increase in width, due either to an increase in the size or the number of

their constituent cells. New uniseriate and multiseriate rays are formed by the cambium, the multiseriate rays arising by lateral enlargement of the uniseriate ones.

As Kribs' (6) and Barghoorn's (4 & 5) investigations have shown, there are various trends of morphological deviation from this primitive type of ray structure. The most significant of these are (1) increase in the size or the number of the multiseriate rays, (2) reduction in the height or the number of the uniseriate rays, (3) reduction in the size or the number of the multiseriate rays and (4) changes in the form and the orientation of the constituent cells of the rays. Certain of these trends of phylogenetic modification are first detectable in the later stages of the ontogeny of the stem or root. Thus, many dicotyledons tend to retain relatively primitive types of ray structures in the first-formed secondary xylem after the rays of the outer wood have become more or less extensively modified. On the contrary, the phylogenetic reduction or elimination of multiseriate rays frequently progresses in an inverse direction, viz. from the earlier toward the later stages of the ontogeny of the secondary body. Under these circumstances, the outer secondary xylem exhibits more primitive types of ray structure than does the first-formed secondary xylem. Therefore, in dealing with rays, it is essential to keep in mind that "the phylogenetic modification of rays is achieved by consecutive series of increasingly modified ontogenies," Barghoorn (4).

GROUP I. ICACINOIDEAE

Trilacunar Icacineae: Vessels with scalariform perforations

The first-formed rays of the secondary xylem of *Calatola, Citronella, Dendrobangia, Emmotum, Oecopetalum, Ottoschulzia, Pennantia Cunninghamii* Miers and *Platea latifolia* Bl. are of the primitive heterogeneous I type. The vertically very extensive multiseriate rays vary somewhat in width, in number and in the shape of their constituent cells. The ontogenetic changes that these rays undergo during subsequent enlargement of the stem fluctuate considerably and give rise in the later-formed wood to different ray patterns that are characteristic of the various genera and species.[1] Thus, in *Oecopetalum guatemalense* Howard, the multiseriate rays tend to retain a slender form, consider-

[1]In this paper, the rays are described and illustrated as seen in tangential longitudinal sections of the xylem. For illustrations of transverse sections of the wood of various representatives of the Icacinoideae, the reader is referred to the plates in the preceding papers of this series, Bailey and Howard (1, 2 and 3).

able height and relative wide spacing in the later-formed wood, *Fig. 1.* Similar widely spaced, high multiseriate rays are formed in *Emmotum holosericeum* Ducke, but they are much broader and are characterized by having a sclerotic modification of their constituent cells. The broadening of the multiseriate rays is much exaggerated in *Ottoschulzia cubensis* (Wright) Urb., *Fig. 7,* and the uniseriate rays are reduced in height and are composed of vertically shortened cells. In the allied genus, *Poraqueiba,* as in various species of *Quercus* and *Casuarina,* the huge multiseriate rays of *P. sericea* Tul. exhibit various stages of phylogenetic dissection into so-called aggregate rays, *Fig. 8.*

There is considerable widening and dissection of the multiseriate rays in the later-formed wood of *Platea latifolia* Bl. and *Pennantia Cunninghamii* Miers, and many of the lower multiseriate rays exhibit a fusiform outline in tangential sections, *Fig. 2.* Such a tendency for widening and dissection of the multiseriate rays is emphasized in various species of *Citronella, Fig. 6,* and is associated with a conspicuous increase in the number of multiseriate rays and a corresponding decrease in the number of uniseriate ones. A similar increase in the number of multiseriate rays at the expense of the uniseriate ones occurs in the wood of *Calatola, Fig. 5,* and certain species of *Apodytes,* but in these plants the multiseriate rays retain a more slender form.

The first-formed secondary xylem of *Anisomallon, Pittosporoides, Cassinopsis,* most species of *Apodytes, Platea excelsa* Bl. and *P. philippinensis* Merr. exhibits various stages of the reduction in width, height and number of the multiseriate rays. As these rays are reduced in width, their constituent cells frequently tend to become more elongated vertically and thus to resemble the cells of the unmodified uniseriate rays. The multiseriate rays of the later-formed wood tend to be reduced in height and width, but not in number. In *Anisomallon* and *Platea, Fig. 3,* they are higher and relatively widely spaced, whereas in *Apodytes, Fig. 4,* they commonly are lower and are very numerous per unit area. Their cells still differ from those of their uniseriate extensions, and from the cells of the independent uniseriate rays, in being radially rather than vertically elongated. This trend of phylogenetic specialization in ray structure, which progresses from the earlier toward the later stages of ontogeny, culminates in other families of the dicotyledons in the elimination of multiseriate rays from the entire secondary xylem. In the Group I Icacinoideae, it progresses only as far as the elimination of multiseriate rays from the first-formed secondary xylem of certain species. Modified forms of relatively primitive heterogeneous I type rays are retained in the later-formed wood.

GROUP II. ICACINOIDEAE

Trilacunar Icacineae: Vessels of the secondary xylem with scalariform-porous perforations

There are three major trends of phylogenetic specialization in the rays of the Group II Icacinoideae. The first of these occurs in *Leptaulus*. In this genus, as in *Apodytes* of the Group I Icacinoideae, there is an obvious tendency to reduce the number of multiseriate rays in the first-formed secondary xylem of the internodal parts of the stem. There is likewise a concomitant tendency to reduce the height and width of the multiseriate rays in the later-formed secondary xylem, but in *Leptaulus*, there is, in addition, a more pronounced tendency for reduction in the height of the uniseriate rays. This leads to the formation of a heterogeneous II type of ray structure, in which the numerous, low, fusiform multiseriate rays have relatively short uniseriate extensions.

The second trend of structural specialization occurs characteristically in *Gonocaryum, Discophora, Stemonurus, Gastrolepis, Urandra* and *Medusanthera*. In the wood of these genera, *Figs. 9, 10 & 11*, as in that of certain species of *Citronella, Fig. 6*, there is a conspicuous tendency for enlargement of the multiseriate rays, but the concomitant reduction in the number of the uniseriate rays is carried much farther than in the Group I Icacinoideae. There is, however, a considerable range of variability in the various species of these genera which illustrates different stages of this salient trend of structural specialization.

The first-formed secondary xylem of *Gonocaryum* usually has rays of the heterogeneous I type, but the number of uniseriate rays varies considerably in different species and in different parts of the same plant. Similar types of ray structure occur in the first-formed secondary xylem of *Gastrolepis austro-caledonica* (Baill.) Van Tiegh., *Lasianthera africana* Beauv., various species of *Stemonurus* and *Discophora*, and certain less modified representatives of *Urandra*, e.g. *U. Ammui* Kanehira and *U. celebica* (Val.) Howard. In other species of *Urandra* and *Stemonurus*, as in *Medusanthera*, the uniseriate rays are much reduced in number, even in the first-formed part of the secondary body.

The enlargement of the multiseriate rays in the later-formed parts of the secondary xylem is not perfectly synchronized with reduction in the height and the number of the uniseriate rays. Thus, in *Gonocaryum, Fig. 9*, and *Stemonurus, Fig. 10*, the multiseriate rays frequently are as large and numerous as in comparable material of *Urandra, Fig. 11*, and *Medusanthera*, but the uniseriate rays are less reduced in height and

in number. In general, the phylogenetic reduction of the uniseriate rays tends to progress from the later-formed toward the first-formed secondary xylem. Therefore, species having a more normal heterogeneous I type of ray structure in the first-formed part of the secondary xylem tend to retain a higher ratio of uniseriate rays in the subsequently formed wood.

A third trend of specialization in the ray structure of the Group I Icacinoideae occurs in *Cantleya corniculata* (Becc.) Howard, *Grisollea Thomassetii* Hemsl. and *Stemonurus Merrittii* Merr. There are more or less numerous, narrow multiseriate, as well as uniseriate, rays in the first-formed secondary xylem of these plants. During subsequent enlargement of the stem, these rays are dissected into lower ones and most of the uniseriate rays widen to form multiseriate ones. Thus, the later-formed secondary xylem is characterized by having numerous, relatively small multiseriate rays and very few uniseriate ones, *Fig. 12.* In *Grisollea Thomassetii* and *Stemonurus Merrittii*, the cells of the remaining uniseriate rays and of the much abbreviated uniseriate extensions of the multiseriate ones are reduced in height. Therefore, in the outer wood of these species, the rays are very nearly of the so-called homogeneous type.

GROUP III. ICACINOIDEAE

Unilacunar Icacineae: Vessels of the secondary xylem with porous perforations

The later-formed secondary xylem of *Mappia, Nothapodytes* and *Merrilliodendron, Fig. 13,* resembles that of various species of *Calatola, Fig. 5,* and *Apodytes, Fig. 4,* in having very numerous, closely spaced, narrow multiseriate rays, as well as many high-celled uniseriate ones. Furthermore, in these genera as in *Apodytes,* there is a conspicuous tendency for reduction in the width of the multiseriate rays in the secondary xylem. On the contrary, the wood of *Desmostachys Vogelii* Stapf, *Fig. 15,* resembles that of *Oecopetalum, Fig. 1,* in having widely spaced, relatively high multiseriate rays, but it differs from the wood of this genus in its much modified uniseriate rays which are composed of a few unusually high cells. In the wood of *Alsodeiopsis, Fig. 14,* as of *Poraqueiba, Fig. 8,* there is a conspicuous phylogenetic tendency for the dissection of large multiseriate rays into so-called aggregate rays. In *A. Staudtii* Engl., *Fig. 14,* this trend of specialization has progressed to a stage comparable to that in various species of the betulaceous genera, *Alnus, Corylus* and *Carpinus.*

The subscandent and scandent representatives of the unilacunar

Icacineae exhibit various stages in the modification of relatively large, widely spaced multiseriate rays. Certain of these trends of phylogenetic specialization progress from the first-formed, toward the subsequently formed, secondary xylem and, therefore, may be studied in stems of herbarium specimens.[2] In such material of *Rhaphiostylis,* the rays are of the heterogeneous I types, and the multiseriate rays extend outward from the interfascicular parts of the stele. A somewhat similar type of ray structure occurs in young stems of *Rhyticaryum elegans* Schellenb. and *R. onocarpum* Sch. & Lautb., but the multiseriate rays tend to be composed of vertically much elongated cells. On the contrary, there is a more or less conspicuous retardation in the formation of multiseriate rays in *Leretia* and *Lavigeria.* The first-formed secondary xylem, particularly of the internodal parts of the stem, is characterized by having numerous high-celled uniseriate and biseriate rays. The multiseriate rays arise abruptly at varying distances from the primary body, frequently from aggregations of narrow rays. This abrupt transition from small-rayed to wide-rayed wood appears to occur at the beginning of a new growth layer. In *Lavigeria,* it coincides with the transition zone between the normal and the large-vesselled anomalous secondary xylem, and the multiseriate rays are composed of very thin-walled, much modified cells. The wood of *Pleurisanthes* is characterized by an evident phylogenetic tendency for the replacement of multiseriate rays by aggregate rays. The first-formed secondary xylem of *Icacina* and *Humirianthera* has numerous high-celled uniseriate, or uniseriate and biseriate rays, but no large stems are available for determining whether multiseriate or aggregate rays are formed during the later-stages of the enlargement of the stem.

Iodeae, Sarcostigmateae, and Phytocreneae

In most species of these highly specialized tribes of climbing plants, there is a more or less conspicuous tendency for the elimination of multiseriate rays from the first-formed secondary xylem. The least modified types of ray structure occur in the young stems of certain representatives of the Iodeae, e.g. *Hosiea sinense* (Oliv.) Hemsl. and Wils. and *Mappianthus iodoides* Hand.-Mazz. There are a few widely separated multiseriate rays in the former species which extend outward from gaps in the primary body. The latter species resembles *Leretia* in having multiseriate rays which commonly arise abruptly at some

[2]Larger stems of several of these genera are not available at present in existing collections.

distance from the stele. The first-formed and more nearly normal secondary xylem of most species of *Iodes* and *Polyporandra* is characterized by having multiseriate rays with or without varying numbers of biseriate or aggregate rays. This type of ray structure predominates throughout relatively thick stems of the Sarcostigmateae, *Fig. 16,* but not of the Iodeae, where much modified multiseriate rays with very thin-walled cells are retained in the later-formed anomalous wood. In the Phytocreneae, multiseriate rays usually are eliminated from young stems except for pairs of wide rays which flank the inwardly projecting strands of phloem.

INTERRELATIONS BETWEEN THE SALIENT TRENDS OF MORPHOLOGICAL SPECIALIZATION IN VESSELS, TRACHEIDS, WOOD PARENCHYMA AND RAYS

We have demonstrated in the preceding papers of this series that the Group I Icacinoideae are characterized by having primitive types of vessels, tracheids and wood parenchyma. They obviously have, in addition, a high ratio of relatively primitive heterogeneous I type rays. On the contrary, the Group III Icacinoideae, which have highly specialized vessels, imperforate tracheary elements and wood parenchyma, exhibit a high ratio of much modified types of ray structures. The Group II Icacinoideae, which show various transitional stages of the modification of the vessels, tracheids and wood parenchyma, likewise illustrate various trends of structural deviation from the primitive heterogeneous I type of rays.

It should be emphasized again in this connection, however, that although the salient lines of phylogenetic specialization in vessels, tracheids, wood parenchyma and rays tend in general to be correlated, the *rates* of these evolutionary modifications are not perfectly synchronized in all cases. Thus, in any particular species or genus; the changes in the rays may have been retarded or accelerated in relation to the specializations of the vessels, tracheids or wood parenchyma.

Group I Icacinoideae

In the case of the Group I Icacinoideae, the most primitive *combination* of structural characters occurs in *Oecopetalum*. The vessel members of *Platea* are structurally somewhat more primitive than those of *Oecopetalum,* but there is an obvious incipient tendency in *Platea* for the vessels to aggregate in radial clusters and for reduction in the number of multiseriate rays in the first-formed secondary xylem, par-

ticularly of the internodal parts of the stem. The most modified vessel members of the Group I Icacinoideae occur in *Emmotum, Ottoschulzia* and *Poraqueiba,* and in these genera the tracheids, wood parenchyma and rays likewise exhibit varying degrees of morphological specialization. In *Emmotum holosericeum* Ducke, the parenchyma is transitional to scanty abaxial paratracheal, and there is a conspicuous enlargement and sclerotic modification of the multiseriate rays in the later-formed wood. In *Ottoschulzia cubensis* (Wright) Urb., the parenchyma is transitional to narrow-banded apotracheal, the bordered pits of the tracheids are reduced in size and the multiseriate rays are greatly enlarged. In *Poraqueiba sericea* Tul., the huge multiseriate rays exhibit various stages of dissection into so-called aggregate rays, but the tracheids have remained more or less unmodified.

All of the remaining representatives of the Group I Icacinoideae, with the exception of certain species of *Citronella,* have retained a primitive type of parenchyma distribution, and all of them, with the exception of *Pennantia,* have relatively unmodified types of tracheids. In *Pennantia,* the bordered pits of the tracheids, as of the vessels, are considerably reduced in size, but the wood parenchyma and rays are of essentially primitive types. Certain species of *Citronella* resemble *Emmotum* in having parenchyma that is transitional to scanty abaxial partracheal. In these species, there are concomitant tendencies for specialization of the vessels and for increasing the size and number of the multiseriate rays at the expense of the uniseriate ones. Although there is a high degree of morphological stability in the tracheids and wood parenchyma of *Anisomallon, Apodytes, Cassinopsis, Dendrobangia* and *Pittosporopsis,* there are obvious trends of specialization in the rays of these genera that are more or less closely synchronized with minor specializations of the vessels. For example, the reduction in the height of the multiseriate rays in the later-formed wood, and in their number in the first-formed secondary xylem, have progressed farther in various species of *Apodytes* than in *Anisomallon.* The vessel members of the latter genus are in general somewhat less modified than those of *Apodytes.*

Group II Icacinoideae

There are at least two, and possibly three, entirely independent lines of coordinated specializations in the Group II Icacinoideae. In the genus *Leptaulus,* the simple porous perforations of the vessels arise primarily by reduction in the number, and a concomitant increase in the size, of the scalariform perforations. The parenchyma is transitional to very scanty diffuse and abaxial paratracheal, the bordered pits of the slender,

thick-walled tracheids are reduced in size, and the numerous uniseriate and narrow multiseriate rays are much reduced in height. On the contrary, in the remaining representatives of the Group II Icacinoideae, the simple porous perforations of the vessels arise by the elimination of more or less numerous bars between the scalariform perforations or, to express the matter ontogenetically, by the cells not forming such secondary wall thickening during tissue differentiation. More or less closely correlated with increasing specialization of the vessels in these plants are conspicuous tendencies for reduction in the number of uniseriate rays, for increase in thickness of the walls of the imperforate tracheary elements, for reduction in the size of their bordered pits, and for modifications in the distribution of wood parenchyma.

The least modified combinations of structural characters occur in species of *Gonocaryum* and *Stemonurus* which have small isolated vessels and relatively high ratios of scalariform and transitional types of perforations. The tracheids have relatively large bordered pits, the parenchyma is either diffuse or transitional to narrow-banded apotracheal, and there is less reduction of the uniseriate rays, particularly in the first-formed parts of the secondary xylem. There is, however, a more or less conspicuous tendency for increase in the size of the multiseriate rays in the later-formed wood of various species of these genera. This tendency for enlargement of the multiseriate rays is accentuated in *Medusanthera* and the uniseriate rays are much reduced in number even in the first-formed secondary xylem. The vessels tend to occur in clusters and have a very low ratio of vestigial scalariform perforations. The imperforate tracheary elements have excessively thickened walls and their bordered pits are much reduced in size. The wood parenchyma is transitional to irregularly banded types in which the vessels are partly or completely embedded.

Discophora, Gastrolepis, Urandra and *Cantleya* are characterized by a tendency for enlargement of the pits in the lateral walls of the vessels, but the structural features associated with this aberrant trend of specialization fluctuate considerably in the different genera. Thus, in *Discophora* the parenchyma is abundant and transitional between diffuse and narrow banded apotracheal, whereas in the other genera it is scanty paratracheal and vestigial diffuse. The large, very thick-walled, imperforate tracheary elements of *Cantleya corniculata* (Becc.) Howard have large bordered pits, whereas those of *Discophora, Gastrolepis* and particularly of *Urandra* are reduced in size. The vessels of *Cantleya* are isolated in distribution, whereas those of *Discophora, Gastrolepis* and *Urandra* are more or less extensively aggregated into clusters. There is

a conspicuous tendency for reduction of the uniseriate rays in all of these genera, but the multiseriate rays in the wood of *Cantleya* differ from those of *Discophora, Gastrolepis* and *Urandra,* as well as of *Gonocaryum, Stemonurus* and *Medusanthera,* in being relatively low and very narrow. Similar small, but more numerous and nearly homogeneous, multiseriate rays occur in herbarium material of *Grisollea* and in the wood of *Stemonurus Merrittii* Merr. However, in the latter plant, the numerous, small vessels tend to occur in radial clusters, the parenchyma is scanty diffuse and abaxial paratracheal, and the slender thick-walled tracheids have small but conspicuous bordered pits. The pits in the lateral walls of vessels of this plant, as of *Grisollea,* are of small size.

Group III Icacinoideae

The structural specializations of the stems of most of the Group III Icacinoideae are obviously complicated by the acquisition of a scrambling or climbing habit of growth. Therefore, it is essential to differentiate trends of phylogenetic modification that occur in trees and shrubs of normal habit of growth from those that are characteristic of subscandent and scandent plants. It should be noted, in addition, that the most reliable means of differentiating the Group III from the Group II Icacinoideae is by their unilacunar nodes. Although the vessels of the non-scandent unilacular Icacineae have prevailingly porous perforations and in general are composed of shorter vessel members, they are only slightly more advanced morphologically than the vessels of such highly modified representatives of the Group II Icacinoideae as *Medusanthera,* where the ratio of vestigial scalariform perforations is very low.

The vessels of *Mappia, Nothapodytes* and *Alsodeiopsis* tend to occur in radial grouping. The wood parenchyma is abundant and transitional to irregular-banded apotracheal and scanty paratracheal. The slender thick-walled imperforate tracheary elements are of reduced length and are provided either with very small bordered pits, *Alsodeiopsis,* or with simple pits, *Mappia* and *Nothapodytes.* In the latter genera, there are numerous uniseriate and multiseriate rays, but the multiseriate rays are reduced in size throughout both the first-formed and later-formed secondary xylem. In *Alsodeiopsis,* there is a conspicuous tendency for the dissection of large multiseriate rays into so-called aggregate rays, and for their elimination from the first-formed secondary xylem. The vessels of *Merrilliodendron* are very large and widely spaced. The wood parenchyma is very abundant and is transitional to loosely banded apotracheal and vasicentric. The numerous uniseriate and small multiseriate rays are closely spaced. The cells of both the rays and the wood

parenchyma are large, resembling those that occur in *Discophora* and *Medusanthera*. The thick-walled imperforate tracheary elements have conspicuously bordered pits.

The vessels in the wood of *Desmostachys Vogelii* Stapf, as in the first-formed secondary xylem of various subscandent and scandent representatives of the unilacunar Icacineae, are reduced in number and exhibit a tendency to occur at least periodically in more or less loosely organized tangential or concentric grouping. The parenchyma fluctuates in abundance and distribution, being transitional between banded apotracheal and paratracheal. The thick-walled imperforate tracheary elements have small conspicuously bordered pits. The widely spaced multiseriate rays resemble those of *Oecopetalum*, but the uniseriate rays of the later-formed secondary xylem are composed of only a few, vertically much extended cells.

The scrambling or climbing representatives of *Humirianthera, Icacina, Lavigeria, Leretia, Pleurisanthes, Rhaphiostylis* and *Rhyticaryum*, as of the Iodeae, Sarcostigmateae and Phytocreneae, exhibit various peculiar and aberrant trends of structural specialization that are correlated with the acquisition of a climbing habit of growth. The most significant of these are tendencies for lateral enlargement and shortening of the vessel members, for the development of curious short tracheids having relatively thin walls and numerous much enlarged bordered pits, for the reduction of banded apotracheal parenchyma to paratracheal types, for the reduction of widely spaced multiseriate rays in the first-formed secondary xylem either to narrow rays or to aggregates of narrow rays, and for either the elimination of multiseriate rays from the later-formed wood, *Sarcostigma*, or their modification into sheets of much modified cells, Iodeae, Phytocreneae and *Lavigeria*.

It should be emphasized, in conclusion, that there is a very wide range of structural variability in different parts of these climbing plants. The material available at present is too fragmentary to serve as a basis for more than a preliminary investigation of their major trends of structural specialization. Extensive collections, particularly of older and larger stems, are essential for making reliable detailed comparisons between the various genera.

SUMMARY

There is a high ratio of relatively primitive heterogeneous rays in the Group I Icacinoideae.

On the contrary, the Group III Icacinoideae have a high ratio of more or less specialized types of ray structures.

The Group II Icacinoideae are transitional and exhibit various trends of morphological deviation from the primitive heterogeneous I type of ray structure.

The interrelations between the salient trends of morphological specializations in the vessels, tracheids, wood parenchyma and rays of the Icacinoideae are discussed in some detail.

Although these trends of specialization tend in general to be more or less closely correlated, the rates of the evolutionary modifications in one category of these tissue cells not infrequently are retarded or accelerated in relation to the changes that are occurring in the other tissue cells.

LITERATURE CITED

1. Bailey, I. W. and Howard, R. A. The comparative morphology of the Icacinaceae I. Anatomy of the node and internode. Jour. Arnold Arb. **22**: 125–132. 1941.
2. ———— ————. The comparative morphology of the Icacinaceae II. Vessels. Jour. Arnold Arb. **22**: 171–184. 1941.
3. ———— ————. The comparative morphology of the Icacinaceae III. Imperforate tracheary elements and wood parenchyma. Jour. Arnold Arb. **22**: 432–442. 1941.
4. Barghoorn, Elso S., Jr. The ontogenetic development and phylogenetic specialization of rays in the xylem of dicotyledons. I. The primitive ray structure. Amer. Jour. Bot. **27**: 918–928. 1940.
5. ————. The ontogenetic development and phylogenetic specialization of rays in the xylem of dicotyledons. II. Modification of the multiseriate and uniseriate rays. Amer. Jour. Bot. **28**: 273–281. 1941.
6. Kribs, D. A. Salient lines of structural specialization in the wood rays of dicotyledons. Bot. Gaz. **96**: 547–557. 1935.

DESCRIPTION OF PLATES

Plate I

Fig. 1. *Occopetalum guatemalense* Howard, *Skutch 2080.* Tangential longitudinal section of the wood, showing typical, heterogeneous I type of ray structure. × 50.

Fig. 2. *Platea latifolia* Bl., *Y. U. 30522.* Tangential longitudinal section of the wood, showing heterogeneous I type of ray structure. × 50.

Fig. 3. *Platea species, Y. U. 20201.* Tangential longitudinal section of the wood, showing modified heterogeneous I type of ray structure. × 50.

Fig. 4. *Apodytes dimidiata* E. Mey., *Y. U. 14833.* Tangential longitudinal section of the wood, showing much modified heterogeneous I type of ray structure. × 50.

PLATE II

FIG. 5. *Calatola costaricensis* Standl., *Y. U. 20921.* Tangential longitudinal section of the wood, showing very numerous high multiseriate rays. × 50.

FIG. 6. *Citronella mucronata* (Ruiz and Pavon) D. Don, *Y. U. 34058.* Tangential longitudinal section of the wood, showing enlarged multiseriate rays. × 50.

FIG. 7. *Ottoschulzia cubensis* (Wright) Urb., *Y. U. 9230.* Tangential longitudinal section of the wood, showing greatly enlarged multiseriate ray. × 50.

FIG. 8. *Poraqueiba sericea* Tul., *Y. U. 19244.* Tangential longitudinal section of the wood, showing aggregate ray. × 50.

PLATE III

FIG. 9. *Gonocaryum calleryanum* Becc., *H. U. 8213.* Tangential longitudinal section of the wood, showing numerous large multiseriate rays and reduced uniseriate rays. × 50.

FIG. 10. *Stemonurus luzoniensis* (Merr.) Howard, *Y. U. 2310.* Tangential longitudinal section of the wood, showing enlarged multiseriate rays. × 50.

FIG. 11. *Urandra scorpioides* (Becc.) O. Ktze., *Y. U. 16043.* Tangential longitudinal section of the wood, showing much reduced uniseriate rays. × 50.

FIG. 12. *Cantleya corniculata* (Becc.) Howard, *Y. U. 12586.* Tangential longitudinal section of the wood, showing small multiseriate and much reduced uniseriate rays. × 50.

PLATE IV

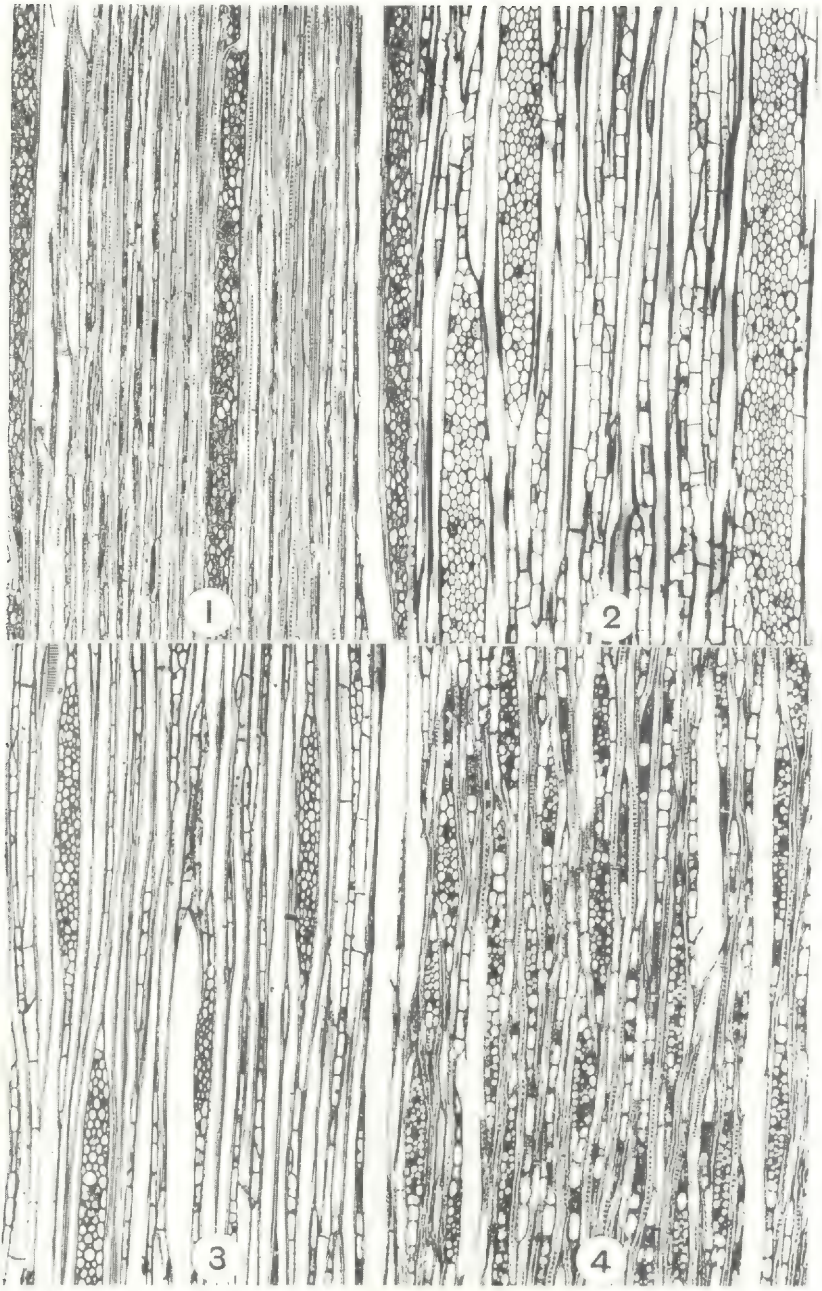
FIG. 13. *Merrilliodendron rotense* Kanehira, *Y. U. 23233.* Tangential longitudinal section of the wood, showing numerous small multiseriate rays. × 50.

FIG. 14. *Alsodeiopsis Staudtii* Engl., *Y. U. 24019.* Tangential longitudinal section of the wood, showing aggregate rays. × 50.

FIG. 15. *Desmostachys Vogelii* Stapf, *Y. U. 19758.* Tangential longitudinal section of the wood, showing widely spaced multiseriate, and very high-celled uniseriate, rays. × 50.

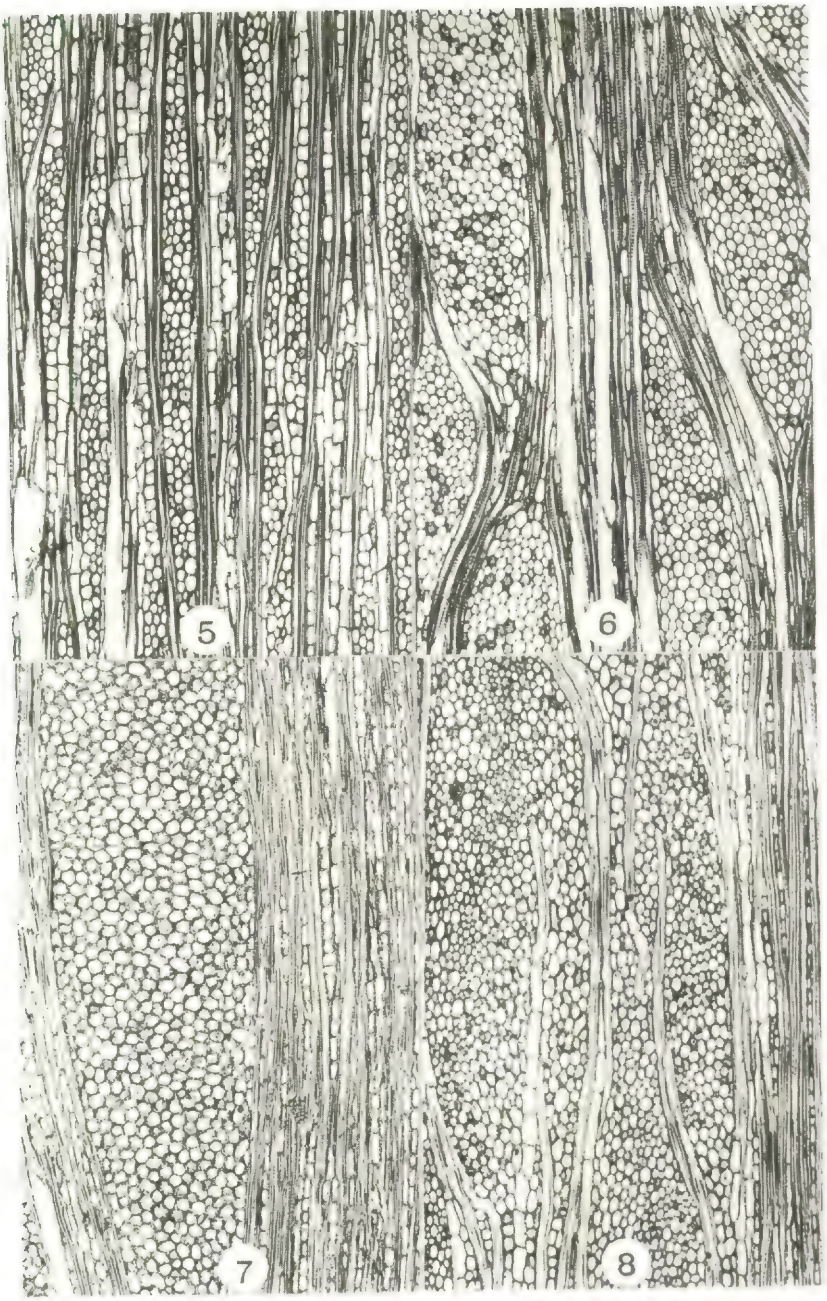
FIG. 16. *Sarcostigma Horsfieldii* R. Br., *H. U. 2771.* Tangential longitudinal section of the wood, showing mostly uniseriate rays. × 50.

BIOLOGICAL LABORATORIES,
HARVARD UNIVERSITY.



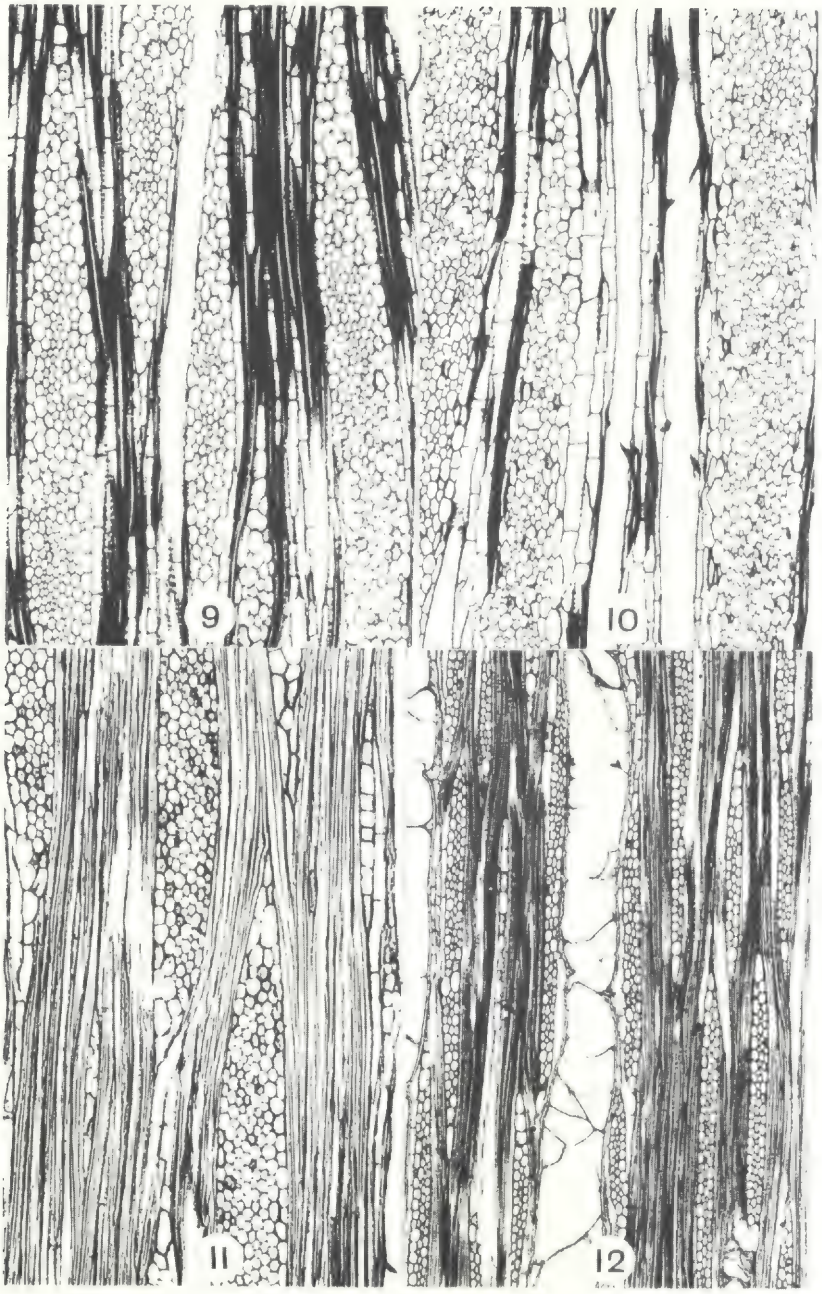
COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE — MERIDEN



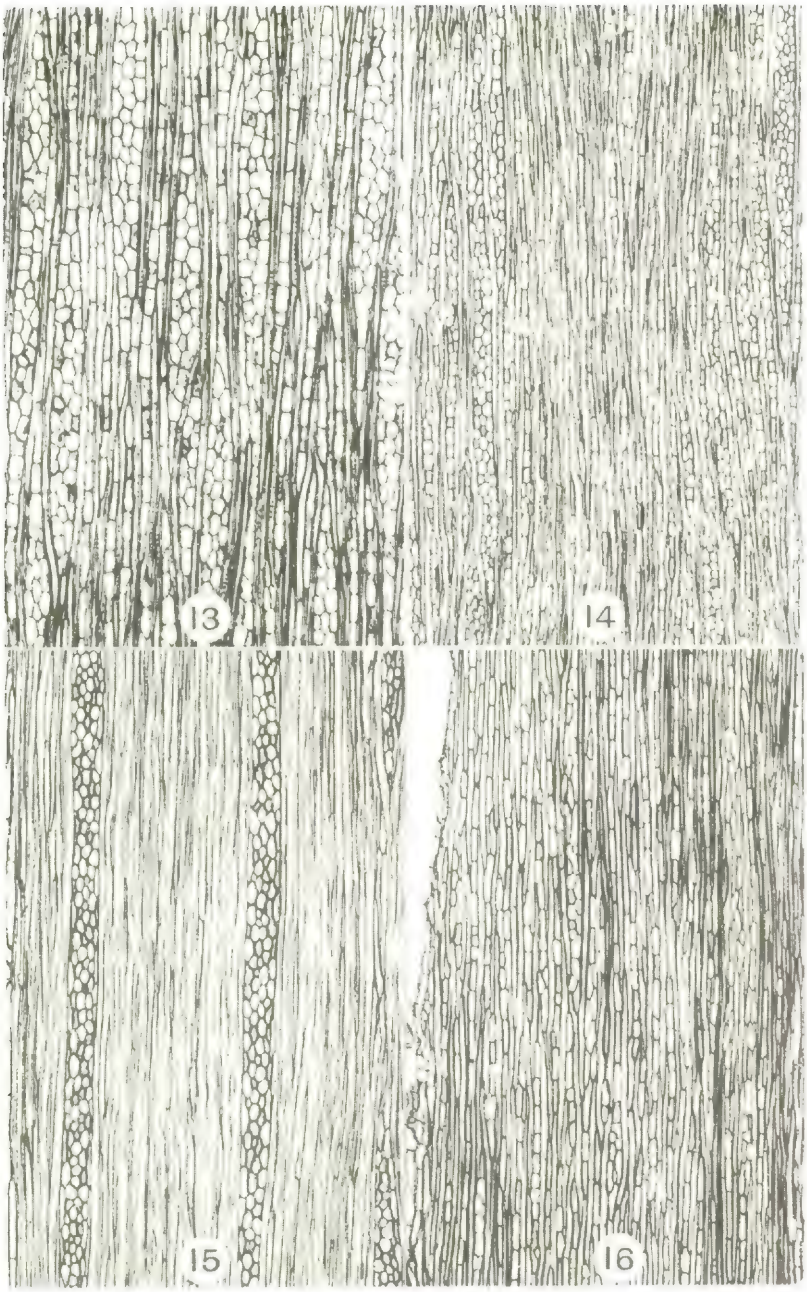
Comparative Morphology of the Icacinaceae

FULL-TONE — MERIDEN



COMPARATIVE MORPHOLOGY OF THE ICACINACEAE

FULL-TONE — MERIDEN



Comparative Morphology of the Icacinaceae

FULL TONE—MERIDEN

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE COLLECTIONS OF THE ARNOLD ARBORETUM

ALFRED REHDER

Cephalotaxus Harringtonia (Forbes) K. Koch, Dendrol. **2,2:** 102 (1873), sensu stricto. — Ascherson & Graebner, Syn. Mitteleur. Fl. **1:** 181 (1897), sensu stricto. — Schneider in Silva Tarouca, Uns. Freil.-Nadelh. 162, fig. 159 (1913), sensu stricto. — Koidzumi in Bot. Mag. Tokyo, **44:** 97 (1930).

Taxus Harringtonia Knight ex Forbes, Pinet. Woburn. 217, t. 66 (1839).
Taxus Inukaja Knight ex Loudon, Encycl. Trees, 943 (1842).
Cephalotaxus pedunculata Siebold & Zuccarini in Abh. Akad. Wiss. Münch. **4,3:** 234 (Fl. Jap. Fam. Nat. **2:** 108) (1846). — Henry in Elwes & Henry, Trees Gt. Brit. Irel. **6:** 1471 (1912).
Cephalotaxus drupacea var. *β. pedunculata* (Sieb. & Zucc.) Miquel in Ann. Mus. Bot. Lugd.-Bat. **3:** 169 (Prol. Fl. Jap. 333) (1867). — Wilson, Conif. Taxads Jap. 8 (1916).
Taxus Sinensis Knight ex Gordon, Pinet. Suppl. 21 (1862) pro syn. *C. pedunculatae.*
Cephalotaxus drupacea var. *Harringtonia* (Forbes) Pilger in Engler, Pflanzenr. (Heft 18) IV.**5:** 102 (1903).

As most authors have adopted the name *C. drupacea* as the name for this species, the full synonymy is given above. Some authors of those who have kept *C. drupacea* as a distinct species, have used *C. Harringtonia* for *C. pedunculata,* as Koch (1873), Ascherson & Graebner (1897), Schneider (1913), Rehder (1914); while almost all authors who united the two species, have done so under *C. drupacea,* as Miquel (1867), Pilger (1903), Wilson (1916), Rehder (1927), except Koidzumi (1930), who accepted *C. Harringtonia* for this concept.

Henry (l.c.) is of the opinion that *C. pedunculata* is probably a hybrid between *C. drupacea* and *C. Fortuni* Hook. If this should be the case, the binary name of the hybrid would be *C. Harringtonia* and *C. drupacea* should be restored to specific rank. The remarks by Rothert (in Ber. Deutsch. Bot. Ges. **17:** 279, foot-note) on the leaf anatomy of *C. Fortuni* do not seem to bear out the possibility of hybridity.

Though it is to be regretted that the nomenclatural type of this species is a plant of doubtful origin, and apparently known only in cultivation, the fact that *"Harringtonia"* is the oldest specific epithet leaves no choice but to accept it under *Cephalotaxus* as the correct binomial. The fol-

lowing two binomial combinations under *C. Harringtonia* have already been made:

Cephalotaxus Harringtonia f. **sphaeralis** (Mast.) Rehder in Mitt. Deutsch. Dendr. Ges. **1915**(24): 213 (1916).

Cephalotaxus pedunculata var. *sphaeralis* Masters in Gard. Chron. n. ser. **21**; 113, fig. 23 (1884).

Cephalotaxus Harringtonia var. **drupacea** (Sieb. & Zucc.) Koidzumi in Bot. Mag. Tokyo, **44**: 98 (1930).

Cephalotaxus drupacea Siebold & Zuccarini in Abh. Akad. Wiss. Münch. **4,3**: 232 (Fl. Jap. Fam. Nat. **2**: 108 (1846). — Endlicher, Syn. Conif. 239 (1847). — Wilson, Conif. Taxads Jap. 6 (1916), which see for additional literature and synonyms.

In addition to these two combinations, the following new combinations are proposed here:

Cephalotaxus Harringtonia f. **fastigiata** (Carr.), grad. nov.[1]

Podocarpus coraianus Siebold in Jaarb. Nederl. Maatsch. Anmoed. Tuinb. **1844**: 34 (1844), nom.

Podocarpus koraiana Endlicher, Syn. Conif. 217 (1847). — Carrière, Traité Conif. 464 (1855); in Rev. Hort. **1863**: 349, fig. (1863).

Cephalotaxus koraiana Hort. ex Gordon, Pinet. 275 (1858), pro synon. — Rothert in Ber. Deutsch. Bot. Ges. **17**: 277 (1899).

Cephalotaxus pedunculata fastigiata Carrière, Prod. Fix. Var. Végét. 44, fig. 1 (1865); Traité Conif. ed. 2, 717 (1867).

Cephalotaxus ? Buergeri Miquel in Ann. Mus. Bot. Lugd.-Bat. **3**: 169 (Prol. Fl. Jap. 333) (1867).

Cephalotaxus Harringtonia l. *koraiana* K. Koch ex Ascherson & Graebner, Syn. Mitteleur. Fl. **1**: 181 (1897).

Cephalotaxus drupacea f. *fastigiata* (Carr.) Pilger in Engler, Pflanzenr. (Heft 18) IV. **5**: 103 (1903). — Wilson, Conif. Taxads Jap. 8 (1916). — Hornibrook in Chittenden, Cult. Conif. Rep. Conif. Confer. 80 (1932) "var. *pedunculata* f.*f.*"

Cephalotaxus Harringtonia var. *fastigiata* Schneider in Silva Tarouca, Uns. Freil.-Nadelh. 162, fig. 161 (1913).

Cephalotaxus Harringtonia var. *coraiana* Koidzumi in Bot. Mag. Tokyo, **44**: 98 (1930).

[1] I have adopted the term gradus novus, new rank, to indicate that the name proposed involves only a change of rank without change of the combination itself, which was first published as *C. Harringtonia* var. *fastigiata* Schneider (l.c.); the name therefore, if cited as a straight trinomial, remains exactly the same whether based on *C. Harringtonia* var. *fastigiata* or f. *fastigiata;* the usual citation "comb. nov." would be incorrect. The term "translatio nova" proposed in 1920 by L. H. Bailey (Gent. Herb. **1**: 8) refers to transfers of epithets without change of rank, while his "status novus" refers to change of rank, such as varieties or forms to a species or a subdivision of a genus to a genus, or vice versa. Both these terms were proposed by Bailey to replace by more definite terms the rather comprehensive term "combinatio nova," but have been so far adopted by only few authors.

Cephalotaxus Harringtonia var. **nana** (Nakai), comb. nov.

Cephalotaxus nana Nakai in Bot. Mag. Tokyo, **33**: 193 (1919).
Cephalotaxus drupacea var. *nana* (Nakai) Rehder in Jour. Arnold Arb. **4**: 107 (1923).

Cephalotaxus Harringtonia var. **koreana** (Nakai), comb. nov.

Cephalotaxus koreana Nakai in Bot. Mag. Tokyo, **44**: 510 (1930).

This plant differs from *C. Harringtonia* var. *drupacea* chiefly in its habit, being a low cespitose shrub, only about 1–1.5 m. high. In its cespitose habit it differs also from the Japanese *C. Harringtonia* var. *nana*, which spreads by creeping rhizomes sending up shoots to 2 m. tall. The var. *koreana* is restricted to Korea according to Nakai who enumerates many specimens from different localities. I have seen only a specimen collected in 1917 by Wilson (No. 9605) at the base of Chirisan, province S. Keisho, which seems to differ from the Japanese varieties in the somewhat narrower and slender leaves inclined to be more falcate; unfortunately, Wilson says nothing of the habit.

Cephalotaxus Harringtonia var. **sinensis** (Rehd. & Wils.), comb. nov.

Cephalotaxus drupacea var. *sinensis* Rehder & Wilson in Sargent, Pl. Wilson. **2**: 3 (1914). — Pilger in Mitt. Deutsch. Dendr. Ges. **1916** (25): 22 (1917).

Carya illinoënsis (Wangenh.) K. Koch, Dendr. **1**: 593 (1869). — Robinson & Fernald, Gray's New Man. Bot. ed. 7, 331 (1908).

Juglans pecan Marshall, Arbust. Am. 69 (1785), nom. subnud.
Juglans illinoinensis Wangenheim, Beitr. Teutsch. Holzger. Forstwiss. Nordam. Holz. 54, t. 18 (1787), descr. fructus mala.
Juglans angustifolia Aiton, Hort. Kew. **3**: 361 (1789).
Juglans alba ϵ. *pacana* Castiglioni, Viaggio Stati Un. **2**: 262 (1790).
Juglans cylindrica Lamarck, Encycl. Méth. **4**: 505 (1798).
Juglans olivaeformis Hort. Paris ex Lamarck, l.c. (1798), pro syn. — Michaux, Fl. Bor.-Am. **2**: 192 (1803).
Carya olivaeformis Nuttall, Gen. N. Am. Pl. **2**: 221 (1818). — C. De Candolle in D.C., Prodr. **16,2**: 144 (1864).
Carya angustifolia Sweet, Hort. Brit. 97 (1827). — Nuttall, N. Am. Sylva, **1**: 41 (1842).
Carya tetraptera Liebmann in Vidensk. Medd. Nat. For. Kjöbenh. **1850**: 86 (1850).
Hicoria Pecan (Marsh.) Britton in Bull. Torr. Bot. Club, **15**: 282 (1888). — Sargent, Silva N. Am. **7**: 137, t. 338 (1895).
Hicorius pecan Sargent in Gard. & For. **2**: 460 (1889).
Carya Pecan Engler & Graebner in Notizbl. Bot. Gart. Berlin, **3**, App. **9**: 19 (1902). — Sargent, Man. Trees N. Am. ed. 2, 177, fig. 169 1922). — Non Nuttall (1842).

Since Britton proposed the combination *Hicoria Pecan*, basing it on

Juglans pecan of Marshall, the epithet has been generally accepted also under *Carya* except by Robinson & Fernald (l.c.) and a few others as correct, although Marshall's name is practically a nomen nudum, or at best a nomen subnudum. The only clue to the identity of the plant is the name Pecan, but without reference to any previous description or mention of it, the habitat given and the statement that the nuts are thin-shelled and that the young plants resemble "our young Pig-nut Hickerys," that is *C. cordiformis* (*Juglans alba minima* Marsh.), not *C. porcina*.

However, even if we accept *Juglans pecan* of Marshall as a valid name, the epithet transferred to *Carya* has no standing, since there is the older homonym of Nuttall (N. Am. Sylva, **1**: 41) of 1842 based on *Juglans Pecan* ? of Walter (Fl. Carol. 236, 1788) which is not *J. pecan* Marsh. and apparently identical with *Carya glabra* var. *megacarpa* (Sarg.) Sarg., though in the absence of a description of the fruit, definite identification is hardly possible.

The next oldest available name for this species is *Juglans illinoinensis* Wangenh. (l.c.) of 1787. He gives a description of the leaves with a figure of a leaf apparently based on plants growing in the nursery of William Prince on Long Island, who received seeds of this species in 1762 from Illinois. Unfortunately, the fruit as illustrated does not belong here, though its description at least partly, except as to the shape which is described as reniform, applies fairly well to the nut of the Pecan.

When K. Koch (l.c.) in 1869 transferred Wangenheim's specific epithet to *Carya,* he changed the spelling to *illinoënsis* which is a more correct spelling for an adjective derived from "Illinois" than *illinoinensis* possibly due to a typographical error or to a slip of the pen; it seems therefore advisable to accept Koch's correction as is also done by Robinson & Fernald, and call this species *Carya illinoënsis* (Wangenh.) K. Koch. Why a name published in such a standard work as the seventh edition of Gray's Manual was neglected is probably due chiefly to the fact that in that publication no extended synonymy could be cited and no reason given for the rejection of the name *C. Pecan.* It seems therefore, advisable to give above the full synonymy with explanatory remarks.

Quercus floribunda Wallich, Num. List no. 2773 (1830), nom. nov.

Quercus dilatata Lindley ex Wallich, Num. List no. 2785 (1830), nom. nud. — Royle, Ill. Bot. Himal. 346, t. 84, fig. 2 (1839), nom.; *"Q. dealbata"* sub tab. — A. de Candolle in DC., Prodr. **16,2**: 41 (1864). — Hooker f., Fl. Brit. Ind. **5**: 602 (1888). — Non Rafinesque (1838).

Quercus floribunda Wallich, Num. List, no. 2773 (1830), nom. nud.

The name *Q. dilatata* Lindl. was not validly published until 1864 by A. de Candolle (l.c.). In 1839 it was mentioned by Royle (l.c.) and a colored figure of a fruiting branch published, but without description. According to Royle, De Candolle (l.c.) and Hooker f. (l.c.), the figure bears the name "Q. dealbata" but in the copy in the Arboretum Library, the name on the plate is "Q. dilatata"; one can see, however, that the plate is apparently of a later issue in which the legend of the plate had been changed.

Since the name *Q. dilatata* was not validly published until 1864 it is a later homonym of *Q. dilatata* Rafinesque, Alsogr. Am. 24 (1838) which must be considered validly published though the description is rather incomplete, being based only on vegetative characters. Rafinesque's species seems to fit best *Q. marilandica* Muenchh. to which it has been referred as a synonym by Trelease, Am. Oaks, 199 (in Mem. Nat. Acad. Sci. **20:** 199) (1924); he also refers to it doubtfully under *Q. stellata* (p. 104). The name is not mentioned by Sargent in his Silva.

For *Q. dilatata* Lindl. ex De Candolle which must be rejected as a later homonym, the name *Q. floribunda* Wall. may be taken up, represented by his No. 2773 which entered into the original description of *Q. dilatata* as given by A. de Candolle. The epithet "floribunda" does not seem to have been used either in *Quercus, Pasania, Lithocarpus* or *Synaedrys* and its adoption therefore cannot be expected to cause any confusion.

To designate as nomen novum an old nomen nudum taken up in place of a name rejected because not conforming to the rules, may not seem literally correct, but having never before been used as a valid name of a species, it must be considered new from a nomenclatural point of view.

Quercus petraea Liebl. f. **insecata** (Rehd.), comb. nov.

Quercus sessiliflora γ. *laciniata* Koehne, Deutsche Dendr. 130 (1893). — H. Späth in Gartenfl. **61:** 497, fig. 54 (1912); in Mitt. Deutsch. Dendr. Ges. **1913**(*22*): 138, fig. 18 (1914). — Non Lamarck & De Candolle (1805).

Quercus sessilis (var. *decipiens*) f. *laciniata* (Koehne) Schneider, Ill. Handb. Laubh. **1:** 197, fig. 102f (1904). — Camus, Chênes, **2:** 230 (1939), pro var., non var. *laciniata* (Lam.) Camus, p. 212.

Quercus sessiliflora f. *insecata* Rehder in Jour. Arnold Arb. **1:** 135 (1919); Man. Cult. Trees Shrubs, 177 (1927).

Quercus petraea f. *laciniata* sensu Rehder, Man. Cult. Trees Shrubs, ed. 2, 167 (1940), quoad descr. et syn.; non (Lam.) Schwarz (1937).

In 1919 I proposed for the oak described as *Quercus sessiliflora* γ. *laciniata* Koehne the name *Q. sessiliflora* f. *insecata* because of the older homonym *Q. sessiliflora* β. *laciniata* (Lam.) Lamarck & De Candolle

of 1805 which represents a spontaneous form differing from the type chiefly in its broader more deeply lobed leaves, as figured by Schwarz, Monog. Eich. Eur. Mittelmeergeb. **2**(Atlas): t. 10, fig. 3, 4, 7 (1936); also Loudon, Arb. Brit. **3**: fig. 1577 apparently belongs here. The form represented by *Q. sessiliflora* γ. *laciniata* Koehne is known only as a cultivated plant; its leaves are elongated and rather narrow with irregular narrow lobes diverging mostly at an angle of less than 45°, otherwise they are very variable; its lobes may be few and remote or more numerous and obtuse to acute or even acuminate. Leaves of this form are figured by Schneider (l.c., fig. 102f) and by Späth (l.c.), in the latter figures reversions to the more typical shape are shown which occur rather frequently in this form.

Schwarz does not mention *Q. sessiliflora* var. *laciniata* Koehne at all, nor f. *insecata;* his *Q. petraea* f. *laciniata* is based solely on *Q. Robur* β. *laciniata* Lamarck (1785). Camus (l.c.) has both forms as valid varieties: *Q. sessilis* var. *laciniata* (Lam.) Camus on p. 212 and *Q. sessilis* var. *laciniata* (Koehne) Schneider on p. 230, without figures.

There can be no doubt that the two forms described as *Q. sessiliflora* var. *laciniata* are quite different and should not be confused. The form based on *Q. Robur* var. *laciniata* Lam. retains its varietal epithet under *Q. petraea* as f. *laciniata* (Lam.) Schwarz, while *Q. sessiliflora* var. *laciniata* Koehne becomes *Q. petraea* f. *insecata* (Rehd.) Rehd.

Aristolochia chrysops (Stapf) Wilson in herb., comb. nov.

Isotrema chrysops Stapf in Bot. Mag. **148**: t. 8957 (1923).

This Chinese specimen of eastern Szechuan and western Hupeh is closely related to *A. heterophylla* Hemsl., and the specimens collected by Wilson (nos. 367 and 4564) are recorded in Plantae Wilsonianae (**3**: 324) under *A. heterophylla.* The plant in cultivation was raised in 1908 from seed of Wilson no. 367. Another new species referred by Stapf to *Isotrema* is *I. lasiops* Stapf in Bot. Mag. **148**: t. 8957, p. [3] in nota (1923) based on Henry no. 4665 and Wilson no. 925, both referred to *A. heterophylla,* Henry no. 4665 by Hemsley (in Jour. Linn. Soc. Bot. **26**: 361, 1891) and Wilson no. 925 by Rehder & Wilson in Plantae Wilsonianae (l.c.). *Aristolochia chrysops* differs from *A. heterophylla* chiefly in the leaves being mostly distinctly hastate at base and in the golden-yellow color of the mouth and of the margin of the dull purple lobes of the perianth.

The generic name *Isotrema* Rafinesque in Jour. de Phys. Paris, **89**: 102. (1819); in Am. Monthl. Mag. **4**: 195 (1819) based on *A. Sipho* is synonymous with *Hocquartia* Dumortier (1822), but has three years'

priority and must be taken up, if the group is separated generically from *Aristolochia*.

Clematis Roylei, nom. nov.

Clematis nutans Royle, Ill. Bot. Himal. 51 (1839). — Hooker f. & Thomson, Fl. Ind. **1**: 10 (1855). — Hooker f., Fl. Brit. Ind. **1**: 5 (1872). — Kuntze in Verh. Bot. Ver. Brandenb. **26**: 129 (Monog. Clem.) (1885). — Non Crantz (1763).

Clematis nutans α. *normalis* Kuntze, l.c. (1885).

As *Clematis nutans* Royle is invalidated by the earlier homonym *C. nutans* Crantz, Stirp. Austr. **2**: 110 (1763); ed. 2, **1**: 127 (1769), the species has to receive a new name. Although *C. nutans* Crantz is illegitimate, being a renaming of *C. integrifolia* L., the later homonym is to be rejected according to Art. 61 of the International Rules of Botanical Nomenclature.

Prinsepia uniflora Batal. var. **serrata,** var. nov.

A typo differt foliis magis distantibus latioribus crenato- vel dentato-serratis, in ramis sterilibus ovato-lanceolatis vel ovato-oblongis manifeste dentato-serratis, 3.5–5 cm. longis et 1–1.5 cm. latis, in ramis floriferis oblongis vel lineari-oblongis, 1.5–4 cm. longis et 0.4–1 cm. latis.

Prinsepia uniflora Farrer in Jour. Roy. Hort. Soc. **42**: 103 (1916).

Prinsepia uniflora Batal. ex F. N. Meyer in U. S. Dept. Agric. Bur. Pl. Indust. Invent. Seeds Pl. Import. **42**: 53, no. 40023 (1918). — Rehder in Jour. Arnold Arb. **5**: 224 (1924), quoad spec. ex Kansu.

China. Kansu: Lien hao shan, Tao River valley below Titao, *J. F. Rock, 13225,* Aug. 1925 (**type**) (spiny shrub, 4 ft.; drupes scarlet, edible); below Lien hao shan, along sandy banks of stream, alt. 2500 m., *J. F. Rock, 13504,* Oct. 1925 (spiny shrub 5–6 ft.; leaves pale green, fruits red, juicy, edible); Valley of Motzuping, *J. F. Rock, 12605,* Apr. 1925 (shrub 3–4 ft.; flowers white to cream); between Choni and Lanchow, alt. 2600–3000 m., *R. C. Ching, 1033,* Sept. 19–21, 1923 (shrub to 7 ft., on clay soil); Upper Tebbu country, banks of Peshwekiang between Tsaruku & Pezhu, alt. 2500 m.; *J. F. Rock, 14564,* Aug. 30, 1926 (shrub 5–6 ft., with drooping branches; fruit wine-red); Lower Tebbu country, Pezhu valley, on low slopes, *J. F. Rock, 14957,* Oct. 1926; near Siku, *R. Farrer, 272* in 1914, seeds (l.c.); near Taochow, *F. N. Meyer, 2161a,* Dec. 1914, seeds (l.c.).

Cultivated: Arnold Arb. 1437–26 (from seed collected by J. F. Rock under 14564) *Kobuski & Roush,* Sept. 9, 1931; *A. Rehder,* Aug. 1, 1941; Arnold Arb. 82–27 (from seed coll. by J. F. Rock under no. 14957) *Kobuski & Roush,* Sept. 9, 1931; *A. Rehder,* Aug. 2, 1941; Arnold Arb. 21610 (seed collected by J. F. Rock under no. 13225) *A. Rehder,* Sept. 2,

1940; U. S. Dept. Agric. Exper. Sta. Chico, Calif., no. 40023 (from seed coll. by F. N. Meyer) *C. C. Thomas*, Oct. 31, 1921.

The variety seems to be restricted to central and southern Kansu and may possibly extend into northwestern Szechuan, while the typical form has a much wider range extending from Ordos, Inner Mongolia, through Shensi, Shansi and Honan to Kiangsu. The variety is easily distinguished from the type by the broader and serrate more distant leaves, on the flowering branches elliptic-oblong or ovate-oblong to linear-oblong and serrulate or crenate-serrulate, on the sterile shoots ovate-oblong to lanceolate and distinctly dentate-serrate, at the base usually broad-cuneate or often nearly rounded. In the type the internodes are shorter and the leaves therefore more crowded, those of the flowering branches generally linear or sometimes narrow-oblong, entire or rarely remotely and indistinctly crenulate; on the sterile branches the leaves are linear to linear- or narrow-lanceolate, cuneate at the base and nearly entire to crenate-serrulate, only on vigorous shoots irregularly dentate-serrate, but always cuneate at the base and narrower and comparatively longer than in the variety. In the fruits and in the flowers there is little or no difference except that the latter are in the type mostly somewhat smaller.

The variety was introduced into cultivation by Frank N. Meyer who in 1915 sent seeds to the U. S. Department of Agriculture; in 1925 and 1926 J. F. Rock also sent seeds to the Department of Agriculture and to the Arnold Arboretum. Plants are growing at the Arnold Arboretum; they have proved perfectly hardy and flower and fruit profusely, while the typical form is blooming well but sets fruit only sparingly. The fruit is acid and juicy, though Farrer (l.c.) states that he found the fruit consisting "of almost nothing but skin and stone."

Caragana sinica (Buc'hoz), comb. nov.

Robinia sinica Buc'hoz, Pl. Nouv. Découv. 24, t. 22 (1779) "R. sinensis" sub tab.

Caragana chamlagu Lamarck, Encycl. Méth. **1**: 616 (1785). — L'Héritier Stirp. Nov. 161, t. 77 (1791). — Bunge in Mém. Div. Sav. Acad. Sci. St. Pétersb. **2**: 90 (Enum. Pl. Chin. Bor. 16) (1833). — Komarov in Hort. Petrop. **29**: 200, t. 5, fig. B (Carag. Monog.) (1909). — Rehder in Jour. Arnold Arb. **7**: 164 (1926).

Robinia chamlagu Hort. Reg. [Paris] ex Lamarck, Encycl. Méth. **1**: 616 (1785), pro synon.

Robinia lucida Salisbury, Prodr. Stirp. Chap. Allert. 337 (1796), nom. illeg.

Robinia chinensis Persoon, Syn. Pl. **2**: 312 (1807), pro synon. *R. Chamlagu*.

Berberis caraganaefolia De Candolle, Reg. Veg. Syst. **2**: 18 (1821).

Caragana chinensis Turczaninov ex Maximowicz in Mém. Div. Sav. Acad. Sci. St. Pétersb. **9**: 470 (Ind. Fl. Pekin.) (1859).
Caragana frutescens L. *β. ussuriensis* Regel in Mém. Acad. Sci. St. Pétersb. sér. 7, **4**,**4**: 44 (1861).
Aspalathus Chamlagu Kuntze, Rev. Gen. **1**: 161 (1891), nom. illeg.

The name cited above under which the shrub generally known as *Caragana Chamlagu* Lam. was first described and figured has been entirely overlooked by all authors and is not listed in Index Kewensis. The description and the figure are apparently based on plants cultivated in the Jardin des Plantes in Paris, and leave no doubt of the identity of the plant; Buc'hoz, moreover, states that the shrub is known as "Schanlaku" which obviously is only a different spelling for Chamlagu.

Zanthoxylum dimorphophyllum Hemsl. var. **deminutum**, var. nov.

A typo recedit foliolis minoribus angustioribusque 1–2.5 cm. longis et 5–9 mm. latis, foliis plerisque trifoliolatis rarissime uni- vel quinquefoliolatis, petiolo distinctius sed anguste alato, inflorescentiis femineis tantum visis 5–10 mm. longis.

China. Yunnan: Kun, Ming, Tai Pu Chi, Mou Ko Sze, *Y. Tsiang 16493,* June 1939, 1 m. (type in herb. Sun Yatsen Univ.; photo in herb. Arnold Arb.). Southern Szechuan: inter Knapi et Tatiaoko, alt. 2600 m.; in decliv. calcar. freq., 2–3 m., *C. Schneider 1353,* May 23, 1914 (Herb. Arnold Arb.).

At the first glance Tsiang's specimen looks quite distinct from any Chinese *Zanthoxylum,* but on closer examination I found that it agrees in all characters except size of leaflets and of the inflorescence with *Z. dimorphophyllum* Hemsl. There is no difference in the essential characters of the prickles, the pubescence, the leaves, the inflorescence and the flowers. The leaflets in typical *Z. dimorphophyllum* represented by eighteen collections are up to 12 cm. long and to 5 cm. broad and usually prominently veined or even reticulate, while in var. *deminutum* they are only obscurely veined on the under side and lustrous above. In the type the number of leaflets is one or three and only in var. *spinifolium* Rehd. & Wils. occasionally five leaflets occur. Tsiang's specimen of var. *deminutum* collected in June, is in flower and clothed with the persistent leaves of the previous year, and is a much-branched shrub 1 m. high with short branchlets, while Schneider's specimen from southern Szechuan collected in May is in young fruit and a shrub 2–3 m. tall with elongated branches bearing only young leaves and along the branchlets young fruit in numerous dense clusters 6–8 mm. high and about as wide, rarely up to 1 cm. high. Schneider's specimen was collected about three degrees further north than Tsiang's specimen at

approximately the same altitude; the habit of the two specimens is quite different and suggests a dry exposed situation for the latter specimen.

Euonymus Maackii Rupr. f. **lanceolata,** f. nov.

A typo recedit foliis multo angustioribus, plerisque lanceolatis vel anguste lanceolatis, 6.5–9 cm. longis et 1.2–2 cm. latis, inferioribus minoribus (in specimine culta) saepe elliptico-lanceolatis 4–6 cm. longis et 1.2–2 cm. latis, longe acuminatis, petiolis 1–1.5 cm. longis gracilibus, ceterum ut in typo.

MANCHURIA: Yakeshish, along the river, *B. F. Skvortzov,* 25. vii, 1930 (**type**) ("affinis *E. Maackii* Rupr. differt foliis lanceolatis").

CULTIVATED: Arnold Arboretum, no. 18333 (seed received in 1923 from Exper. Farm, Echo Sta., Manch.), *A. Rehder,* July 2, 1940.

At the first glance, this form with its long narrow-lanceolate slender-stalked leaves looks quite distinct from *Euonymus Maackii* Rupr., but the cultivated plant approaches somewhat the typical form in the lower leaves of the branchlets being shorter and broader, more elliptic-lanceolate. Also among the spontaneous material of *E. Maackii* in our herbarium there are specimens with the leaves, at least those toward the end of the branchlets distinctly lanceolate, as Komarov, Fl. Mansh. no. 1040, leg. *F. Karo,* Fl. Amur, circa Sachalien, 1905, and *Skvortzov,* Kirin prov., Cher Station, Aug. 30, 1922. From Korea intermediate specimens are *R. Y. Mills* (Wilson Exped.) Kanghai, prov. N. Heian, June 20, 1919 and *U. Faurie 520,* Chinnampo, the holotype of *E. coreanus* Lévl.

Nakai in 1926 (in Bot. Mag. Tokyo, **40:** 573) referred *E. Vidalii* var. *stenophylla* Koidzumi (in Bot. Mag. Tokyo, **31:** 32. 1917) to *E. Maackii* as a synonym, which led me to suspect that it might possibly be identical with the narrow-leaved form of *E. Maackii,* but finding that forms of *E. Vidalii* Franch. & Sav. (*E. yedoensis* Koehne) also exist in Hondo, e.g. a specimen collected by J. G. Jack near Lake Yumoto, Aug. 11, 1905, I doubt if Nakai was correct in referring Koidzumi's variety to *E. Maackii*; I have not seen the type of Koidzumi's variety, nor any other specimens so named.

Lonicera codonantha (sect. Isoxylosteum), sp. nov.

Frutex erectus metralis, ramulis flavido-brunneis villosis, vetustioribus griseis, cortice longitudinaliter fisso; gemmae pluriperulatae perulis ovatis acuminulatis. Folia decidua, ovalia vel ovato-ovalia, 1–2 cm. longa, obtusa et leviter mucronulata, basi rotunda vel subcordata, supra obscure viridia, glabra costa impressa villosa excepta, subtus villosa, venis utrinque 3–5, supra impressis subtus leviter elevatis, costa mani-

festius elevata; petioli brevissimi circ. 1 mm. longi, villosi. Flores axillares in parte superiore ramulorum, bini in pedunculo circ. 2 mm. longo glabro; bracteae lanceolatae, ovarium subaequantes, sparsissime ciliatae, bracteolae 4, distinctae, subrotundae, trientem ovarium subaequantes, glabrae; calycis dimidio ovario paulo longioris dentes ovati, obtusiusculi, glabri, triente inferiore connati; corolla campanulata, extus glabra, roseo-alba, tubo 6–7 mm. longo et (compresso) 6 mm. lato, intus fauce ultra medium piloso et basi nectariis 5 donato, lobis rotundatis 4 mm. longis intus piloso dimidium tubum aequantibus; stamina 5, in triente inferiore tubi inserta, medium tubum paullo superantia, antheris oblongis filamentis glabris subaequilongis; stylus glaber, staminibus brevior, stigmate capitato; ovaria subglobosa, 3 mm. alta, trilocularia, loculis pluri-ovulatis. Fructus ignotus.

Affinis *L. rupicolae* Hook. f. & Thoms., sed recedit corollae tubo manifeste latiore, filamentis longioribus, calyce, bracteolis bracteisque glabris, foliis latioribus obtusis vel obtusiusculis brevissime petiolatis.

China. Yunnan: Chenkang, Hsiaoshuishan, Snow Range, alt. 3500 m., open and rocky slopes, *T. T. Yü, 17188,* Aug. 4, 1938 (**holotype**) (shrub 2–4 ft., flowers pinkish white).

This new species seems most closely related to the Himalayan *L. rupicola* Hook. f. & Thoms., which differs chiefly in the narrower corolla-tube with the lobes glabrous inside, compressed 3–4 mm. wide, in the pubescent bracts, ciliate bractlets and calyx-lobes, and in the narrower acute or acutish leaves on slenderer pedicels 1.5–4 mm. long.

Lonicera Myrtillus Hook. f. & Thoms. var. **cyclophylla,** var. nov.

A typo recedit foliis suborbicularibus vel late ovalibus 0.6–1 cm. longis, pedicellis folio longioribus 8–12 mm. longis, bracteis suborbicularibus circ. 3 mm. latis, cupula bracteolarum trientem tantum ovarii tegentibus; proxima var. *depressae* (Nichols.) Rehd. sed foliis bracteisque suborbicularibus et cupula manifeste breviore distinguitur.

China. Yunnan: Taron-Taru Divide, Mt. Tarulaka, alt. 3000 m., open and rocky slope, *T. T. Yü, 20056,* Sept. 3, 1938 (**type**) (shrub 1 ft., flower purplish pink).

This variety at the first glance looks quite distinct from *L. Myrtillus,* but is apparently only a variety close to var. *depressa* and differing from it chiefly in the smaller suborbicular to broad-oval leaves and the suborbicular bracts.

Arnold Arboretum,
Harvard University.

A NEW WILLOW FROM FLORIDA

WILLIAM A. MURRILL AND ERNEST J. PALMER

With one text-figure

THE discovery by the senior author of an undescribed species of willow in the remote hammocks of central Florida, where it appears to be endemic, adds another interesting plant to the flora of the state and of the southeastern United States, where very few species of *Salix* are known. The species is apparently rather rare and local, but several plants were growing in the colony where it was discovered and at the other cited localities.

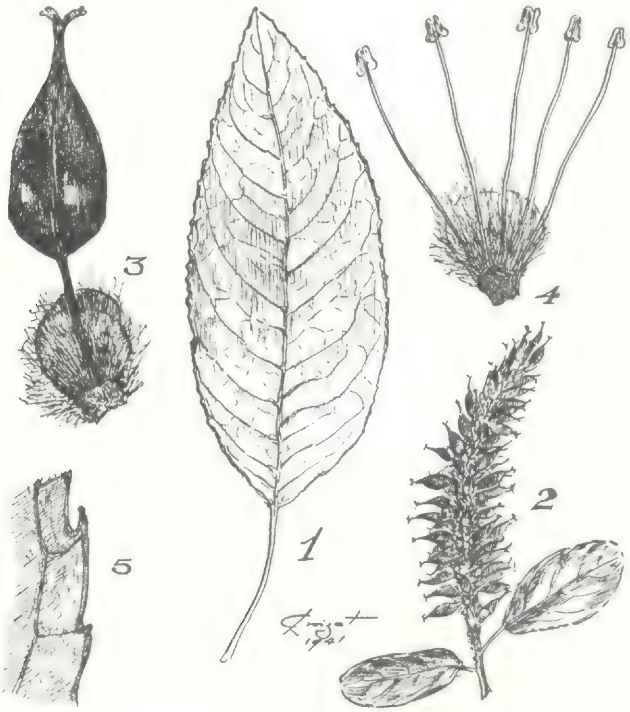
Salix astatulana, sp. nov.

Frutex vel arbor ad 4 m. alta, ramulis novellis pubescentibus, cortice fere laevigato cinereo parce maculato-striato. Folia juvenilia villosa, matura satis firma, supra glabra vel in costa parce pubescentia, subtus villosa vel raro fere glabra, plerumque 5–12 cm. longa, 2–4 cm. lata, oblongo-ovata vel oblongo-elliptica, apice obtusa, acuta vel breviter acuminata, basi rotunda vel raro subcordata, margine toto leviter undulato vel minute glanduloso-serrato; petiolo puberulo, 0.8–1.5 cm. longo. Stipulae minutae grosse serratae mox deciduae. Amenta cylindrica densiflora brevipedunculata, interdum foliis parvis 1–3 suffulta; rhachis dense pilosa; squamae fuscae oblongo-obovatae, 2–3 mm. longae, intus dense villosae, extus fere glabrescentes basi et margine exceptis, apice rotundo vel fere truncato. Amenta mascula circiter 4–6 cm. longa, 1–1.5 cm. crassa, filamentis 3–6 infra parce pilosis, 5–7 mm. longis. Amenta foemina circiter 3.5–5 cm. longa, 1.5 cm. crassa; fructus elongato-ovati, 5–7 mm. longi, 1.5–2 mm. crassi, adulti glabri, apice in stylum bifidum sensim contracti, pedicello parce villoso 2–3 mm. longo.

In rich, humid soil of deep, low hammocks near streams, in Lake and Levy Counties, Florida, and probably in adjoining Counties. Fruit ripening about the middle of March.

LAKE CO., near Astatula, *W. A. Murrill & J. R. Watson,* Feb. 4 and March 7, 1941 (TYPE); Lake Harris, near Tavares, *W. A. Murrill,* Dec. 5, 1940 and Feb. 5, 1941. LEVY CO., Culf Hammock, *Murrill & Watson,* Feb. 23, 1941. (TYPE, Arnold Arb. herb., isotype and paratypes, Univ. of Fla. herb.).

In flower and fruit characters *Salix astatulana* appears to be most nearly related to *Salix longipes* Shuttleworth. It is, however, a very different plant in its foliage, and it is distinguished by its more densely flowered aments, much longer filaments, more slender capsules, and the nearly glabrous outer surface of the scales. The specific name is for the town of Astatula, near the type locality. It is of Indian origin and is said to signify "sunset on the waters."



EXPLANATION OF TEXT-FIGURE

1. Leaf (× ½); 2. pistillate ament (× ½); 3. capsule and inside of scale (× 5); 4. staminate flower with inside of scale (× 5); 5. serration of leaf-margin (× 6).

Experiment Station, University of Florida.
Arnold Arboretum, Harvard University.

THE ARNOLD ARBORETUM DURING THE FISCAL YEAR ENDED JUNE 30, 1941

IN SPITE of unsettled economic conditions due to the European war, the Arnold Arboretum is still the fortunate recipient of important and extensive extra-budgetary support from numerous individuals interested in the institution and its work. Unrestricted gifts to the Cultural Purposes Fund amounted to $7382.00 from 357 individuals. Special contributions of $1600.00 were made to the George B. Emerson Fellowship, bringing the total to date for these fellowships to $5125.00. Through the generosity of Mr. John S. Ames, a member of our Visiting Committee, $2500.00 was provided for the purchase of that part of the Rowe Contracting Company's old quarry site on the Arboretum side of Centre Street. This is a timely gift that will, in the not distant future, enable us to eliminate an unsightly spot adjoining the Arboretum on its most extensively travelled approach. During the year the permanent endowment funds were increased by the receipt of $12,880.56 from the estate of the late Miss Grace L. Edwards of Boston, the balance of her bequest of $25,000.00, and $23,054.90 from the estate of Mrs. Caroline S. Freeman, the latter to be added to the Laura Lucretia Case fund. Five thousand dollars was presented by Professor James R. Jewett, under the conditions that from the income the James R. Jewett and Vieno T. Johnson prizes may be awarded annually by the Arnold Arboretum to individuals who have made noteworthy contributions to the improvement of our native beach plum and other native and introduced fruits. The first awards will be made in August, 1941. One thousand six hundred seventy-three dollars and seventy-seven cents was added to the principal of two special endowment funds in accordance with the original terms of gift appertaining to the original James Arnold fund and the Charles Sprague Sargent bequest. Through the interest of Mrs. Augustus H. Eustis and Mrs. Frederic Channing Bowditch, descendants of James Arnold, the Arboretum received as a gift an interesting association piece in the form of an elaborate table formerly owned by James Arnold. This is a round table, fifty-three inches in diameter, the top being a mosaic of polished ornamental marbles, semi-precious and other stones, and it now graces the conference room in the Administration Building.

The most serious situation that faces the institution at present is the very badly overcrowded conditions of the library and especially the

herbarium, and there is little chance of expansion on the basis of available space in the present administration building. For several years past, temporary expedients have been adopted, and shifts in the sequences of both books and herbarium material made until the possibilities on the basis of present floor space are about exhausted. As noted in the herbarium report below, no further general distributions of reference material into the herbarium are possible, because of the already overcrowded condition of the herbarium cases. It was hoped that this overcrowded condition might be met by the construction of a major building to take the three large botanical libraries and herbaria belonging to Harvard University, the combined collections of the Gray Herbarium, the Arnold Arboretum, and the Farlow Reference Library and Herbarium. To the library resources of these units the extraordinary library facilities of the Museum of Comparative Zoology might be added, thus forming one comprehensive biological library to serve all the biological units of the University, to replace the four large independent libraries now being maintained. This would be a major move, but unfortunately there seems to be little chance of its being consummated for financial reasons. In the meantime it has become imperative to construct a modest addition to the Gray Herbarium building to take care of the critical storage situation there. The solution of the equally pressing space problem at the Arnold Arboretum apparently forces us to consider the possibility of a reasonable addition to the present administration building. In the meantime all space for books, reference material, office space, and accommodations for staff members, resident investigators, visitors, and students is at a premium, with no relief in sight other than some additional building space.

Retirements and Appointments. — As noted in the report for the previous year, Professor Alfred Rehder, Curator of the Herbarium, retired on August 30, 1940, as Associate Professor Emeritus, having reached the age of 75 years, and Dr. J. H. Faull, in charge of Plant Pathology, became Professor Emeritus on the same date. Both individuals served the institution with distinction, the former for a period of forty-two years, and the latter for twelve years. Because of certain adjustments that it was most desirable to make in connection with the genetics situation, it has unfortunately not been possible, as yet, to make a replacement appointment in plant pathology. Professor Rehder continues to occupy his old desk, working on special botanical and nomenclatural problems, but concentrating on the preparation of a bibliographical supplement to his Manual of Cultivated Trees and

Shrubs. Dr. A. C. Smith of the New York Botanical Garden staff reported for duty as Curator of the Herbarium on October 1, 1940, succeeding Professor Rehder.

Buildings and Grounds. — The general operations in reference to buildings and grounds have proceeded as in the past few years. The widening of Bussey Street between the Arboretum proper and the Peters Hill section has been completed by the Park Department, while current repairs have been made to road surfaces, walks, and benches. The dry season characteristic of the late summer and early fall of 1939 resulted in a considerable amount of winter injury to certain shrubs, but losses were negligible. The task of preparing the detailed planting maps initiated several years ago has been completed, there now being on file 101 completed panels showing the exact positions of all planted trees and shrubs within the Arboretum limits. As changes are made in the plantings, corresponding alterations are made on these detailed maps and on the card catalogue record, the objective being to keep these maps and records strictly up to date. In checking the maps, which also involved a critical re-identification of many of the planted species, it is revealed that there are now in actual cultivation at the Arnold Arboretum approximately 6500 named species and varieties of hardy ligneous plants.

During the winter, 3400 display labels were prepared and the majority of these were placed in position in the spring. A reserve supply is now available, as with certain changes in the technique of painting and lettering it has become possible greatly to increase the output without a corresponding increase in personnel. A new type of direction sign has been devised, the basis being thick swamp cypress lumber, finished in natural color, with the lettering machine carved. Thirty-one of these were prepared and installed during the year. They have the advantage of being practically unbreakable, and the carved letters cannot be easily obliterated. Furthermore, they can be retained in place summer and winter, without the necessity of removal for repainting, as was necessary with the old smooth surface painted signs which these new ones have replaced. The general design, which is distinctly attractive, has been adopted by the Trustees of Public Reservations for their holdings in Massachusetts.

Through the generosity of Mr. John S. Ames, the Arboretum has fortunately been able to acquire that part of the old quarry site on Centre Street formerly owned by the Rowe Contracting Company. This small triangle situated on the south side of Centre Street, and bounded on one

side by Bussey Street, but separated from the Arboretum property by the abandoned right of way of old Centre Street, has long been more or less an eye sore, marring the approaches to the Arboretum. This tract will be placed in an attractive condition as soon as the City of Boston completes its projected improvement of the juncture of Bussey Street with Centre Street. This was the last piece of privately owned property on the Arboretum side of Centre Street, and it is now naturally pleasing to the Arboretum authorities and the Park Department that it has been acquired for Arboretum purposes.

The popularity of the Arboretum continues to increase, this being reflected in the annually increasing numbers of visitors. A close estimate on Lilac Sunday, May 18, 1941, indicated approximately 44,000 pedestrians in the grounds on that one day. That these numerous visitors are, for the most part, interested in plants, is evidenced by the fact that following this, and other Sundays and holidays at the season of greatest attractiveness in May and June, there are practically no papers or other rubbish left in the grounds, and there are also no evidences whatever of breakage of flowering shrubs and trees, reflecting great credit on the citizens of Boston and vicinity.

Horticulture. — The past winter was not unusually cold and there was a protective covering of snow on the ground much of the time. During the latter part of March, however, after the snow had melted but while the ground was still frozen, several days with high temperatures, strong winds, and low humidity were experienced. These factors combined resulted in more winter injury than in any winter since the severe one of 1933–34. While losses of individual plants were negligible, the killing of branches necessitated a great deal of extra pruning during the spring and early summer. Fortunately, our rhododendrons were not as severely injured as were corresponding plantings in neighboring towns. Some of the conifers suffered rather severely.

During the spring planting season, 389 different species and varieties were added to the permanent collections by transfer from the nursery. Two hundred seven selected *Malus* and *Prunus* hybrids were planted on the Walter Street tract, while on certain hurricane devastated areas, 250 hemlock, 50 white pine, and 40 red pine plants were placed. It is of interest to record the fact that in spite of war conditions, we received in one shipment from England, six weeks in transit, about fifty species of trees, shrubs, and vines, mostly not hitherto represented in American collections. Two shipments of seeds from western China were also received.

The total number of living plants received from institutions in the United States, England, Canada, Hawaii, and Sumatra, was 1500. At the same time, 69 lots of scions were received for propagation work, and 107 packets of seeds, selected from the larger number received, were actually planted in the greenhouse. At the same time 4516 living plants were distributed, 438 lots of scions, and 1103 packets of seeds, this material going to various parts of the United States and Canada, Cuba, Australia, Great Britain and Hungary. From the Yunnan seed accessions, Lu Shan Botanic Garden and the Fan Memorial Institute Yunnan Expeditions, 476 packets of seeds were distributed to various institutions.

A new collection of one hundred twenty-nine named ornamental crabapples has been installed in the Peters Hill section across the driveway from the old established collection of these attractive plants. This planting is planned to replace the poplar collection which was largely destroyed by the hurricane. Within a few years this should form a very attractive display. The poison ivy eradication campaign has been prosecuted as in the past few years, but much remains to be done on the elimination of this most attractive, yet distinctly noxious plant. In addition to the development of the larger nursery on the Walter Street tract, a definite plan has been developed for renovating the soil in the old nurseries in the Bussey Institution grounds.

In the field of inter-institutional cooperation a part of the propagating grounds has been assigned to the Massachusetts College of Pharmacy, where the institution is installing a comprehensive living collection of medicinal plants.

After several seasons experience in color photography, and because of the unique opportunity offered by the very large collection of living plants available in the Arboretum plantings, a definite plan of recording the characters of selected plants in bloom, in fruit, and in autumn foliage has been developed. For this purpose 35 mm. Kodachrome film is used. During May and June about 300 natural color slides were added to this rapidly increasing collection.

A serious attempt is made to keep the interested public posted on the attractions of the Arboretum and the services it renders. Through articles in the daily press, in weekly and monthly magazines, and in Arnoldia (the new name of our Bulletin of Popular Information), and by illustrated lectures to special groups of horticulturally minded people, the more popular and practical phases of the institutional work are presented, and the value of these activities is reflected by the constantly

increasing demands on the Arboretum for material, advice, and assistance, resulting in an ever increasing heavy burden of correspondence.

Cytogenetic Laboratory. — The plant breeding program has been continued with species hybridization in lilacs, apples, cherries, azaleas and roses. Second generation progeny of some of the species hybrids are being grown to provide a wide variety of new types for selection. Naturally cross pollinated species also have provided natural hybrids. Several thousand species hybrids are growing in the propagating beds and nurseries.

The work on X-ray effects has been continued during the past winter. It was found that irradiation had no effect on subsequent X-ray sensitivity. The exponents of dosage curve equations for complex chromosomal aberrations varies from 1 to 2 depending on X-ray intensity.

Mr. Nichols has found frequent spontaneous chromosomal aberrations in root tips from old seed and from seed subjected to high temperatures. Dr. Giles found that spontaneous chromosomal aberrations in *Tradescantia* are much more frequent in triploids than in the diploid and tetraploid parents.

Supplementing the work in genetics as prosecuted in the past few years, the appointment of Dr. P. C. Mangelsdorf on the staff of the Botanical Museum, but financed in part by Arnold Arboretum funds, has enabled us to take part in his extensive corn breeding work, a part of this being centered at the Atkins Institution of the Arnold Arboretum at Soledad, Cienfuegos, Cuba, and a part in our own experimental grounds.

Wood Anatomy. — During the year 789 microscopic slides of wood sections were added to the reference collections, making a total of 24,382 available for study, representing 7,065 species. From various sources, 538 wood specimens were received, forming important additions to this large collection. The totals are now 5,278 species represented by 9,324 individual collections, (preserved material) and 5,959 represented by 11,857 specimens (dried material). In the Icacinaceae study, Professor Bailey and Mr. Howard have continued their anatomical studies, and their work has been supplemented by a study of the pollen characters by Dr. Dahl and of the trichomes and crystals by Mr. Heintzelman. Dr. Heimsch has concluded an extensive study of the comparative anatomy of the secondary xylem of the Geraniales and the Sapindales, and Mr. Reed has initiated a comparative study of the Olacales and Santalales. Dr. Barghoorn has published the last of his series of studies

on the ontogenetic and phylogenetic interpretation of the rays of the gymnosperms and the angiosperms, while Dr. Nast has continued her investigations along similar lines appertaining to wood parenchyma of the angiosperms. To an increasing degree the taxonomists on the Arboretum staff call for assistance in the detailed study of puzzling forms, in an attempt to supplement studies on the basis of the older taxonomic techniques by additional data, often of great significance, appertaining to wood anatomy, pollen and trichome structure.

The Herbarium. — During the year 19,413 mounted specimens were inserted into the herbarium. A total of 26,770 specimens was mounted, some of these being ready for insertion and others being still under study. The total number of specimens now filed in the herbarium is 513,880.

The number of specimens (including duplicates) received by exchange, gift, subsidy, purchase, or for identification was 94,474. Of these 42,591 are from North and South America, 23,232 from India and Indo-China, 12,058 from Polynesia, 10,635 from China, 2,936 from Malaysia, 1,050 from Papuasia, and 1,972 from Africa, the Philippines, Japan, and Australia. Important American collections received were 5,126 specimens collected by Donovan Correll in Louisiana, about 8,300 specimens collected by J. W. Thompson in western North America, about 3,000 specimens collected by G. Martinez-Calderon in Mexico, 3,247 specimens sent by the Universidad Nacional de Tucumán, Argentina, and about 2,000 specimens collected by Verne Grant in Central America. Dr. I. M. Johnston's summer campaign in northern Mexico resulted in his securing about 6,000 specimens. Important Asiatic collections received were about 22,000 specimens (including duplicates) collected in Indo-China by W. T. Tsang (with the cooperation of Lingnan University), about 4,500 specimens collected by T. T. Yü in Yunnan, about 2,000 specimens from western China sent by the Lu-Shan Botanical Garden, about 2,500 specimens from Szechuan, China, sent by Nanking University, and about 12,000 specimens (including duplicates) collected in Fiji by Otto Degener (during the Pacific cruise of the "Cheng Ho," sponsored by Mrs. Anne Archbold).

The total number of specimens distributed by the Arboretum was 42,445, of which 40,497 went to American institutions. Of these, 32,253 were sent in continuation of exchanges, 4,591 as gifts, and 2,161 for identification by specialists. To the Gray Herbarium 10,769 specimens and 1,130 mounted illustrations accompanying descriptions were transferred, while 3,119 specimens were transferred to the Farlow Herbarium and 504 specimens of orchids and numerous orchid descriptions and

illustrations were sent to the Ames Orchid Herbarium at the Botanical Museum. To foreign institutions 1,948 specimens were sent, while books to the equivalent value of 4,146 specimens were exchanged under a special arrangement. Thus the total number of specimens or their equivalent sent out was 47,721. In addition, many thousands of specimens were packed and stored for shipment to European institutions as soon as conditions permit.

Thirty-three loans, totalling 1,275 specimens, were made to 16 American institutions. For study by staff members, 89 loans with a total of 8,142 specimens were received from 28 institutions, for the most part American.

The card catalogue of references to new species and other important literature appertaining to woody plants was increased by 3,300 cards, the total now being 129,119 cards. The collection of negatives representing types and critical specimens now totals 4,047, 21 having been added during the year.

Routine herbarium work included a continuation of the division of large genera into geographic series; all the larger genera are now so arranged and a beginning has been made toward breaking down all the Old World herbarium material in the smaller genera. Insertion of mounted specimens into the herbarium involved considerable shifting, certain families being removed from sequence and placed in the Conifer Room, where a rearrangement had made the coniferous families more compact. This appears to be the last makeshift which will be possible without additional floor space for herbarium expansion. Mounting was more or less limited to collections from regions under study by staff members; many important collections from other regions remain unmounted due to lack of labor and space. During the year many thousands of clippings, typed descriptions, and illustrations were incorporated into the herbarium.

Members of the herbarium staff continued study in their special fields, with the result that numerous manuscripts were prepared for publication and many thousands of routine determinations made. Professor Rehder, who retired from active duty at the end of August, 1940, continued to visit the herbarium daily and to work on a bibliographical supplement to his Manual of Cultivated Trees and Shrubs. Dr. Smith, taking up his duties on October 1, 1940, studied special families of the Arboretum's extensive Papuasian collections, and undertook preliminary work on the Degener Fijian collection. Dr. Johnston, aided by a grant from the Milton Fund, continued his cooperation with the Carnegie Institution. His summer field work in northern Coahuila, Mexico, was

eminently successful. In addition to extensive work on his own collections, he has continued his identification work on Boraginaceae sent to him by numerous correspondents for study, and has continued the work of identification of the large collections obtained by Professor T. H. Goodspeed of the University of California and his associates in the arid parts of Chile and Peru. Dr. Raup continued his studies of the flora of Arctic America by preparing a report on his MacKenzie Mountains expedition collections of 1939. During the year he has ordered up the very extensive herbarium collections of North American *Salix*, determining several hundred specimens. Through a study of 1,054 specimens from the Peace and Upper Liard River regions sent to him by eight collectors and correspondents, he has added 227 species to his published catalogue of the plants of these regions. Dr. Kobuski has continued his studies of the Theaceae, giving special attention to the American genera. Mr. Palmer has continued his studies of western American plants and his collections of cultivated plants in the Arboretum. Dr. Allen has extended her work on the Lauraceae of the Old World and especially of Papuasia, also making numerous determinations in the genus *Halenia* in America. Dr. Perry has continued to study the extensive series of New Guinea plants received from the Richard Archbold Expeditions and other sources. Dr. Croizat has studied many genera of the Euphorbiaceae, extending his work on this difficult family. Under my supervision, Miss Luetta Chen has continued her study of the genera *Ormosia* and *Sabia*, while Mr. H. L. Li has commenced a study of the Chinese species of Araliaceae. Professor F. P. Metcalf of Lingnan University, with the aid of a Guggenheim Foundation Fellowship, worked at the Arboretum throughout the year in continuation of his work on the Flora of Fukien Province, China. My own work was largely concentrated on the preparation of a comprehensive report on the Captain F. Kingdon Ward collections from Upper Burma (Vernay-Cutting Expedition), a study of the accumulated Indo-China material and certain groups of our very extensive and as yet unnamed Chinese collections, the determination of various Philippine collections, and other accumulations from India, Burma, and Malaysia.

Field Work. — Aside from the work in Mexico prosecuted by Dr. I. M. Johnston, mentioned above, and which will be continued during the summer of 1941, our field work has been largely prosecuted through the granting of modest subsidies to individuals in various countries to enable them to undertake botanical exploration for the Arnold Arboretum. Grants were made during the past year to Señor Guadalupe

Martinez-Calderon for work in Oaxaca, Mexico, Mr. Otto Degener for work in Fiji, Mr. Robert L. Pendleton for work in Thailand, Mr. E. E. Smith for work in Colombia, Mr. J. W. Thompson for work in the Puget Sound region, Mr. James H. Soper for work in Ontario, Dr. T. H. Goodspeed for work in South America, and the National Szechuan University for work in western China. The continued unsettled conditions in China have interfered with the transmission of collections from the field, but extensive collections made in previous years are in safe storage in western China, while certain most important collections were delivered safely, especially the very large Indo-China collections, some 2,800 numbers, with extensive duplicates, made in cooperation with Lingnan University. In Cuba, extensive summer collecting was done by Messrs. Dahl, Howard, Godfrey, and Hodge, the former a staff member of the Division of Biology, the last three graduate students in botany, through assistance and fellowship awards through the Atkins Institution of the Arnold Arboretum.

The Library. — The extent of the library in bound volumes at the end of the fiscal year was 44,812, in unbound volumes several hundred, in pamphlets 12,957, in photographs 18,662, and in nursery catalogues several thousand, representing a net increase for the year of 306 bound volumes, 231 pamphlets and 18 photographs. Six interesting views of Mt. Vernon, photographed by Professor C. S. Sargent, were presented by Mrs. Mary Sargent Potter of New York City. There were added to the catalogue 1130 cards, 530 of them containing bibliographical data, and 1036 slips were added to the files which continue the printed author and subject catalogues of the library. Sixteen new periodicals were acquired and several new exchanges of publications arranged. Many books have been sent out on inter-library loans, and the requests for microfilms and photostats have been more numerous than in previous years. Over 2200 photographs were printed on order for the Montreal Botanical Garden from the negatives made by E. H. Wilson on his expeditions to eastern Asia. The checking of the periodicals of the library for inclusion in the new edition of the Union List of Serials has been completed. Shelf lists have been made for the six alcoves and main corridor in the periodical section, and this has greatly facilitated the work of reference and research. Our large collection of forestry periodicals, numbering approximately 1730 volumes, was deposited in the library of the Harvard Forest at Petersham when Shaler Hall was completed in May. James H. and Ralph Lowell made a gift of 33 books, totaling in value about $700, in memory of their father, John Lowell,

Harvard 1877. One of our rarest folios, Thornton's "Temple of Flora," was requested as a special loan by the R. H. Macy Company of New York City, for the purpose of reproducing four of its colored plates for sale. The library has received as a gift a set of these excellent reproductions. A list of duplicate publications for sale or exchange has been prepared and will be ready for distribution at an early date.

Atkins Institution of the Arnold Arboretum, Soledad, Cienfuegos, Cuba. — In the planting expansion program a number of palms were moved into the palm section, and several hundred shrubs and trees were transplanted into the newly acquired areas. In the additional area transferred to the garden in February 1939 by the Soledad Sugar Company, the last cane crop has been harvested, so that all the land is now available for planting and development. Naturally with a restricted and modest income, as the planted areas are increased, a higher percentage of the income has to be used for maintenance purposes, so that the expansion of the plantings must of necessity be slow. It has been necessary to extend the nursery area, and Dr. Mangelsdorf's tropical American corn varieties being grown at Soledad have required the preparation of land for this purpose. A new entrance to the gardens was made at the corner of the recent addition below Casa Catalina, thus making the approach more direct. During the year 340 packets of seeds and 759 living plants were received and 433 packets of seeds, 46 living plants, and 53 lots of cuttings were distributed. Mr. Sturrock's book on tropical fruits for southern Florida and Cuba and their uses was published through the cooperation of the Arnold Arboretum in 1940, the income from sales being impounded for the use of the Atkins Institution. About forty individuals enjoyed the hospitality of Harvard House for varying periods of time, the most that have taken advantage of the facilities available in any one year since the institution was organized. These included fourteen representatives of Harvard University working on various botanical and zoological problems. Other educational institutions represented include Wilson College, the University of Colorado, the University of Ohio, Skidmore College, the University of Montreal, Colegio de la Salle, and the University of Havana. Other institutions and organizations represented were the Fairchild Tropical Garden, the New York Botanical Garden, Montreal Botanical Garden, the Cleveland Museum of Natural History, the Ohio Division of Plant Industry, United Fruit Company, and Cuban Agricultural Experiment Station. A group of four, under the leadership of Mr. and Mrs. Warren H. Corning, representing the Cleveland Museum of Natural History, made the Atkins

Institution their headquarters for about a month while collecting natural history material for that institution. Among the Harvard staff members and students were Messrs. Gunckel, Salvin, Dahl, Howard, Hodge, and Godfrey, who spent extended periods in the summer of 1940 working on various botanical problems, and Messrs. Dethier and Greenway, prosecuting zoological work. An extensive series of botanical specimens representing Cuban species was presented by Mr. José Carabia. The comprehensive collecting campaign initiated by Messrs. Dahl, Howard, Godfrey, and Hodge in the summer of 1940 will be continued during the summer of 1941, the objective being to secure the material on which a reasonably comprehensive flora of southern Santa Clara Province may be based.

During the year the Atkins Institution was the fortunate recipient of gifts totalling $4,426.68 for current expenses and special work, of which $2,200.00 was an anonymous gift to provide for the reconstruction and enlargement of the greenhouse and neighboring lath house, and for the construction of a public shelter house connecting these two units. Mrs. Edwin F. Atkins provided $1000.00 for expenses of visiting students and investigators, and $190.00 for an additional steel herbarium case, while Dr. Thomas Barbour provided $836.08, of which $300.00 was for student assistance, the balance for general expenses.

Publications. — As usual the quarterly numbers forming our Journal were issued, the amount of technical material from staff members now taxing the available space. Beginning with the first number for 1941 our Bulletin of Popular Information was renamed Arnoldia, thus honoring James Arnold, whose original bequest received in 1872 made possible the establishment of the Arnold Arboretum. As in past years, articles published in the Arboretum serials represent only a part of the work of the staff members. A bibliography of the published writings of the staff and of students working under the supervision of staff members is appended.

Bibliography of the Published Writings of the Staff and Students July 1, 1940 — June 30, 1941

ALLEN, C. K. Studies in the Lauraceae, III. Some critical and new species of Asiatic Lindera, with occasional notes on Litsea. Jour. Arnold Arb. **22**: 1–31. 1941.

BAILEY, I. W. The walls of plant cells. A.A.A.S. Publ. **14**: 31–43. 1940.

——— & HOWARD, R. A. The comparative morphology of the Icacinaceae, I. Anatomy of the node and internode. Jour. Arnold Arb. **22**: 125–132, *4 pl.* 1941.

——— & HOWARD, R. A. The comparative morphology of the Icacinaceae, II. Vessels. Jour. Arnold Arb. **22**: 171–187, *6 pl.* 1941.

BARGHOORN, E. S., JR. The ontogenetic development and phylogenetic specialization of rays in the xylem of dicotyledons, I. The primitive ray structure. Am. Jour. Bot. **27**: 918–928, *17 fig.* 1940.

——— The ontogenetic development and phylogenetic specialization of rays in the xylem of dicotyledons, II. Modification of the multiseriate and uniseriate rays. Am. Jour. Bot. **28**: 273–282, *17 fig.* 1941.

——— The ontogenetic development and phylogenetic specialization of rays in the xylem of dicotyledons, III. The elimination of rays. Bull. Torrey Bot. Club **68**: 317–325, *14 fig.* 1941.

——— & BAILEY, I. W. A useful method for the study of pollen in peat. Ecology **21**: 513–514. 1940.

CONGER, A. Chromosome deficiencies in microspores of Tradescantia. Jour. Heredity **31**: 339–341. 1940.

CROIZAT, L. A discussion of new and critical synonymy. Jour. Arnold Arb. **22**: 133–142. 1941.

——— Euphorbia Mayuranathanii Croizat. Hook. Ic. Pl. **35**: *t. 3404.* 1940.

——— A further comment on stability in nomenclature. Science **93**: 109–110. 1941.

——— Identifying woody plants in winter. Am. Nurseryman **72**(12): *7–8, 2 fig.* 1940; **73**(5): 9–10, *3 fig.*, (8): *7–9, 2 fig.* 1941.

——— New and critical Euphorbiaceae from eastern tropical Asia. Jour. Arnold Arb. **21**: 490–510. 1940.

——— Notebook records of leaves. Am. Nurseryman **72**(6): 11–12, *1 fig.* 1940.

——— Notes on the Dilleniaceae and their allies: Austrobaileyeae subfam. nov. Jour. Arnold Arb. **21**: 397–404. 1940.

——— Notes on new and critical Far Eastern Phyllanthus. Jour. Jap. Bot. **16**: 646–658. 1940.

——— On the origin and publication of the name Longetia. Chron. Bot. **6**: 102. 1940.

———— On the phylogeny of the Euphorbiaceae and some of their presumed allies. Revista Univ. (Univ. Católica de Chile) **25**: 205–220, *1 fig.* 1940.

———— A significant new species from New Guinea: Euphorbia euonymoclada Croiz., n. sp. Bull. Jard. Bot. Buitenzorg III. **16**: 351–357. 1940.

———— On the systematic position of Daphniphyllum and its allies. Lingnan Sci. Jour. **20**: 79–104, *11 fig.* 1941.

———— A voice from the dim past. Cactus & Succ. Jour. **13**: 62. 1941.

———— & Hara, H. Critical notes on some Formosan Euphorbiaceae, II. Jour. Jap. Bot. **16**: 383–390. 1940.

———— & Metcalf, F. P. The Chinese and Japanese species of Daphniphyllum. Lingnan Sci. Jour. **20**: 105–127, *pl. 1–3.* 1941.

Giles, N. The effect of fast neutrons on the chromosomes of Tradescantia. Proc. Nat. Acad. Sci. **26**: 567–575. 1940.

Heimsch, C., Jr. Wood anatomy and pollen morphology of Rhus and allied genera. Jour. Arnold Arb. **21**: 279–291, *3 pl.* 1940.

Johnston, I. M. The floristic significance of shrubs common to North and South American deserts. Jour. Arnold Arb. **21**: 356–363. 1940.

———— Gypsophily among Mexican desert plants. Jour. Arnold Arb. **22**: 145–170. 1941.

———— New phanerogams from Mexico, IV. Jour. Arnold Arb. **22**: 110–124. 1941.

———— Preparación de ejemplares botanicos para herbario. Traducido del Inglés al Castellano por H. R. Descole y C. A. O'Donell. Tucumán. 1941. 1–49, *6 pl.* 1941.

———— El significado florístico de los arbustos comunes a los desiertos norte y sudamericanos. Revis. Argent. Agron. **8**: 114–121. 1941.

———— Studies in the Boraginaceae, XV. Notes on some Mexican and Central American species of Cordia. Jour. Arnold Arb. **21**: 336–355. 1940.

Kobuski, C. E. A brief glossary of the more common botanical and horticultural terms. Arnold Arb. Bull. Pop. Inf. iv. **8**: 37–56. 1940.

———— The Oleaceae of New Guinea collected by L. J. Brass. Jour. Arnold Arb. **21**: 328–335. 1940.

———— Studies in the Theaceae, VI. The genus Symplococarpon Airy-Shaw. Jour. Arnold Arb. **22**: 188–196. 1941.

Merrill, E. D. The Atkins Institution of the Arnold Arboretum, Soledad, Cienfuegos, Cuba. Arnold Arb. Bull. Pop. Inf. iv. **8**: 65–74, *pl. 8–10.* 1940.

———— The same, abridged. Parks & Recreation **24**: 246–251, *2 fig.* 1941.

———— The herb garden at the Harvard Botanic Garden. Herbarist **7**: 36, *2 fig.* 1941.

———— A note on the dates of publication of Wight's "Icones plantarum Indiae orientalis." Jour. Arnold Arb. **22**: 222–224. 1941.

———— Records of Indo-Chinese plants, II. Jour. Arnold Arb. **21**: 364–391. 1940.

———— A simple change in name. Arnoldia **1**: 1–2. 1941.
———— & CHUN, W. Y. Additions to our knowledge of the Hainan flora, III. Sunyatsenia **5**: 1–200, *pl. 1–28, fig. 1–22*. 1940.
———— & PERRY, L. M. Plantae papuanae Archboldianae, III, IV, V, VI. Jour. Arnold Arb. **21**: 292–327, 1 fig., 511–527. 1940; **22**: 32–59, 253–270. 1941.

NICHOLS, C. Spontaneous chromosome aberrations in Allium. Genetics **26**: 89–100. 1941.

PALMER, E. J. & PICKENS, A. L. A new form of Crataegus viridis L. Neighborhood Res. **4**: 61. 1940.

RAUP, H. M. Botanical problems in boreal America. Bot. Rev. **7**: 147–208, 209–248. 1941.
———— List of plants collected by H. F. Conn in Arctic America, 1938. Castanea **6**: 8–10. 1941.
———— An old forest in Stonington, Connecticut. Rhodora **43**: 67–71. 1941.
———— & CARLSON, R. E. The history of land use in the Harvard Forest. Harvard Forest Bull. **20**: 1–64, *9 fig.* 1941.

REHDER, A. Abies procera, a new name for A. nobilis Lindl. Rhodora **42**: 522–524. 1940.

RICK, C. M. On the nature of x-ray induced deletions in Tradescantia chromosomes. Genetics **25**: 466–482. 1940.

SAX, K. The effect of radiation on chromosome structure. Am. Phil. Soc. Yearbook **1940**: 240–241. 1940.
———— & O'MARA, J. G. Mechanism of mitosis in pollen tubes. Bot. Gaz. **102**: 629–636. 1941.
———— & SWANSON, C. P. Differential sensitivity of cells to x-rays. Am. Jour. Bot. **28**: 52–59, *6 fig.* 1941.

SEELER, E. V., JR. A monographic study of the genus Thyronectria. Jour. Arnold Arb. **21**: 429–460, *5 pl.* 1940.
———— Two diseases of Gleditsia caused by a species of Thyronectria. Jour. Arnold Arb. **21**: 405–427, *4 pl.* 1940.

SMITH, A. C. The American species of Hippocrateaceae. Brittonia **3**: 341–555, *12 fig.* 1940.
———— Nomenclatural notes on Araliaceae. Trop. Woods **66**: 1–6. 1941.
———— Notes on Old World Hippocrateaceae. Am. Jour. Bot. **28**: 438–443. 1941.
———— Studies of Pacific Island plants, I. Bull. Torrey Bot. Club **68**: 397–406. 1941.
———— Studies of Papuasian plants, I, II. Jour. Arnold Arb. **22**: 60–80, 231–252. 1941.

SMITH, E. C. Chromosome behavior in Catalpa hybrida Spaeth. Jour. Arnold Arb. **22**: 219–221. 1941.

STURROCK, D. Tropical fruits for Southern Florida and Cuba and their uses. Jamaica Plain, Mass. 132 pp. 8°. 1940.

SWANSON, C. P. The distribution of inversions in Tradescantia. Genetics **25**: 438–465. 1940.

WYMAN, D. Again, rose species. Am. Rose Ann. **26**: 46–48. 1941.

———— Berries; spring-flowering shrubs that in summer produce colorful berries. House & Garden Sept. 1940, Sec. I: *29*, 70–71, *6 fig.* 1940.

———— Elms planted in America. Trees Mag. **3**(4): 7, 13–14, *3 fig.* 1940; (II) **4**(1): 14, 16–17, *3 fig.* 1941.

———— A few hybrid crabapples. Nat. Hort. Mag. **20**: 52–54. 1941.

———— A few more oriental crabapples. Nat. Hort. Mag. **20**: 132–135, *2 fig.* 1941.

———— The handsome honeysuckles. House & Garden Oct. 1940, Sec. I: 32–33, 80–81, *9 fig.* 1940.

———— The hardiness map. Am. Rose Ann. **26**: 117–119. 1941.

———— A hardiness map for the United States. Arnold Arb. Bull. Pop. Inf. iv. **8**: 61–64, *pl. 7.* 1940.

———— Hardiness zones in the United States. Parks & Recreations **23**: 507–510. 1940.

———— Laburnum alpinum. Parks & Recreation **24**: 301–302. 1941.

———— Rhododendron injury. Arnoldia **1**: 33–36, *pl. 2.* 1941.

———— Shrubs; upwards of a hundred flowering shrubs and vines will flourish in dense or semi-shade. House & Garden Aug. 1940, Sec. I: 40–41, Sec. II: 41, 43, *7 fig.* 1940.

———— 1941 sources for rare woody plants. Arnoldia **1**: 5–18; Supplementary list, *21–28.* 1941.

———— Various forms of the Japanese yew. Horticulture **19**: 51–52, *3 fig.* 1941.

———— The white flowering Rhodora. Arnoldia **1**: 3–4. 1941.

———— Winter injury and serious pests to be fought now. Arnoldia **1**: 37–40. 1941.

Staff of the Arnold Arboretum, 1940–41

ELMER DREW MERRILL, S.D., LL.D., Arnold Professor of Botany and Director.

JOHN GEORGE JACK, Assistant Professor of Dendrology, Emeritus.

ALFRED REHDER, A.M., Associate Professor of Dendrology and Curator of the Herbarium, Emeritus.

JOSEPH HORACE FAULL, Ph.D., Professor of Forest Pathology, Emeritus.

IRVING WIDMER BAILEY, S.D., Professor of Plant Anatomy.

KARL SAX, Ph.D., Professor of Cytology.

PAUL CHRISTOPH MANGELSDORF, S.D., Professor of Botany.

ALBERT CHARLES SMITH, Ph.D., Curator of the Herbarium.

IVAN MURRAY JOHNSTON, Ph.D., Associate Professor of Botany.

HUGH MILLER RAUP, Ph.D., Assistant Professor of Plant Ecology.

CLARENCE EMMEREN KOBUSKI, Ph.D., Assistant Curator of the Herbarium.

DONALD WYMAN, Ph.D., Horticulturist.

ERNEST JESSE PALMER, Collector and Research Assistant.

CAROLINE KATHRYN ALLEN, Ph.D., Assistant in the Herbarium.

LILY MAY PERRY, Ph.D., Technical Assistant.

LEON CROIZAT, J.D., Technical Assistant.

JANET RYTHER SELLARS, A.B., Librarian.

VLADIMIR CONSTANTIN ASMOUS, A.B., Assistant Librarian.

SUSAN DELANO MCKELVEY, A.B., Research Assistant.

CONSTANCE MANSFIELD GILMAN, Business Secretary.

LOUIS VICTOR SCHMITT, Superintendent.

WILLIAM HENRY JUDD, Propagator

INDEX

Synonyms are printed in *italics;* new names in **bold-face** type.

Acronychia **elliptica,** 56
— **goniocarpa,** 57
— melicopoides, 57
— Pullei, 58
— **rhytidocarpa,** 55
— trifoliolata, 58
Additions to our knowledge of the figs of New Guinea, 81
Agrostis asperula, 213
— corralensis, 214
— limonias, 213
Alchornea Mairei, 429
Allen, Caroline K. Studies in the Lauraceae, III, Some critical and new species of Asiatic Lindera, with occasional notes on Litsea, 1
Ampelocissus acetosa, 375
Anatomy of the node and internode, The comparative morphology of the Icacinaceae I, 125
Andropogon Bequaerti, 137
Anthobembix **Brassii,** 239
— **myrtifolia,** 238
Anulocaulis leiosolenus, 156
Aperula assamica, 1, 2
Aplopappus Johnstonii, 164
— *texanus,* 169
Archboldianae, Plantae Papuanae, 32, 253, 375, 529
Aristolochia **chrysops,** 574
Arnold Arboretum during the fiscal year ended June 30, 1941, The, 582
Arnold Arboretum, Staff of the, 598
Aspalathus Chamlagu, 577
Atriplex **reptans,** 111, 156
— **Stewartii,** 110
Bailey, I. W. & R. A. Howard. The comparative morphology of the Icacinaceae, I, Anatomy of the node and internode, 125
— The comparative morphology of the Icacinaceae II, Vessels, 171
Bailey, I. W. & R. A. Howard. The comparative morphology of the Icacinaceae III. Imperforate tracheary elements and xylem parenchyma, 432
— The comparative morphology of the Icacinaceae IV. Rays of the secondary xylem, 556
Bailey, I. W. & A. C. Smith. Brassiantha, a new genus of Hippocrateaceae from New Guinea, 389
Baileyoxylon, 143
— **lanceolatum,** 143
Beilschmiedia parvifolia, 9
Benzoin commune, 8
— *erythrocarpum,* 15
— *glaucum,* 8
— *hypoglaucum,* 15
— *hypoleucum,* 15
— *Laureolum,* 9
— *pedunculatum,* 11
— *pulcherrimum,* 20
— *sericeum tenue,* 17
— *sinoglaucum,* 8
— *strychnifolium Hemsleyanum,* 25
— *subcaudatum,* 23
— *umbellatum,* 13
— — *hypoglaucum,* 15
— *urophyllum,* 23
Berberis caraganaefolia, 576
Bibliography of the published writings of the staff and students, July 1, 1940 —June 30, 1941, 594
Brass, L. J. The 1938–39 Expedition to the Snow Mountains, Netherlands New Guinea, 271, 297
Brassiantha, a new genus of Hippocrateaceae from New Guinea, 389
Brassiantha, 389
— **pentamera,** 390
Buchanania *auriculata,* 535
— heterophylla **pubescens,** 531
— macrocarpa, 530

Buchanania *macrophylla*, 534
— mollis, 529
— **solomonensis**, 530
— **Versteeghii**, 531
Callitriche **papuana**, 258
Calogyne pilosa, 388
Calophyllum **Brassii**, 352
— **congestiflorum**, 349
— costatum, 351
— **Kajewskii**, 353
— *lanceolatum*, 345
— papuanum, 348
— **pauciflorum**, 348
— **procerum**, 344
— **savannarum**, 352
— **solomonense**, 346
— trachycaule, 346
— vitiense, 347
— Warburgii, 345
Campnosperma auriculata, 535
— **Brassii**, 535
— macrophylla, 534
— montana, 533
Caragana *chamlagu*, 576
— *chinensis*, 577
— *frutescens ussuriensis*, 577
— **sinica**, 576
Carya *angustifolia*, 571
— illinoënsis, 571
— *olivaeformis*, 571
— *Pecan*, 571
— *tetraptera*, 571
Catalpa hybrida Spaeth, Chromosome behavior in, 219
Cayratia **grandifolia**, 378
— japonica, 379
— **lineata**, 379
— — **fusco-lanata**, 379
— **megacarpa**, 379
Celastrus **novoguineensis**, 260
Celtis, **Kajewskii**, 254
— **similis**, 253
Cenesmon hainanense, 430
— *laoticum*, 428
— *lineare*, 428
— *peltatum*, 428
— *Poilanei*, 428
— *tonkinense*, 429
Cephalotaxus *Buergeri*, 570
Cephalotaxus *drupacea*, 570
— — *fastigiata*, 570
— — *Harringtonia*, 569
— — *nana*, 571
— — *pedunculata*, 569
— — *sinensis*, 571
— Harringtonia, 569
— — *coraiana*, 570
— — drupacea, 570
— — **fastigiata**, 570
— — *fastigiata*, 570
— — *koraiana*, 570
— — **koreana**, 571
— — **nana**, 571
— — **sinensis**, 571
— — sphaeralis, 570
— *koraiana*, 570
— *koreana*, 571
— *nana*, 571
— *pedunculata*, 569
— — *fastigiata*, 570
— — *sphaeralis*, 570
Chromosome behavior in Catalpa hybrida Spaeth, 219
Cissus *acetosa*, 375
— *adnata*, 376
— assamica, 377
— conchigera, 376
— *grandifolia*, 378
— hypoglauca, 378
— indica, 376
— *lineata*, 379
— — *fusco-lanata*, 379
— *megacarpa*, 379
— *pyrrhodasys*, 378
— simplex, 378
Clavistylus peltatus, 426
Clematis *nutans*, 575
— — *normalis*, 575
— **Roylei**, 575
Cleyera, Studies in the Theaceae, VII, The American species of the genus, 395
Cleyera, 397
— albo-punctata, 399
— **Bolleana**, 403
— **cernua**, 404
— **costaricensis**, 410
— **Ekmani**, 401
— *elegans*, 465

Cleyera integrifolia, 401
— japonica, 397
— **Matudai,** 403
— *mexicana,* 402
— nimanimae, 411
— — *viridula,* 411
— **panamensis,** 412
— **revoluta,** 405
— serrulata, 407
— **Skutchii,** 408
— *syphilitica,* 401
— **tacanensis,** 406
— **ternstroemioides,** 416
— theaeoides, 413
— **vaccinioides,** 415
Cnesmone **anisosepala,** 429
— **hainanensis,** 430
— javanica, 427
— **laotica,** 428
— **linearis,** 428
— **Mairei,** 429
— **peltata,** 428
— **Poilanei,** 428
— **tonkinensis,** 429
Colubrina **papuana,** 264
Comparative morphology of the Icacinaceae, I, Anatomy of the node and internode, The, 125
Comparative morphology of the Icacinaceae, II, Vessels, The, 171
Comparative morphology of the Icacinaceae III, Imperforate tracheary elements and xylem parenchyma, The, 432
Comparative morphology of the Icacinaceae IV, Rays of the secondary xylem, The, 556
Corynocarpus australasica, 541
Cosson's "Illustrationes Florae Atlanticae" 1882–1897, A note on the dates of issue of the fascicles comprising, 455
Croizat, Leon. A discussion of new and critical synonymy, 133
— The tribe Plukenetiinae of the Euphorbiaceae in eastern tropical Asia, 417
Crypteronia Cumingii, 270
Cymbopogon Bequaerti, 137
Dalea filiciformis, 159
Dalrymplea javanica, 547
— *pomifera,* 546
Daphnandra novoguineensis, 251
Daphnidium pulcherrimum, 20
Dicranocarpus parviflorus, 164
Dillenia alata macrophylla, 498
— *auriculata,* 501
— *ingens,* 501
— *macrophylla,* 498
Discussion of new and critical synonymy, A, 133
Drimyspermum Perrottetianum, 265
Drymaria elata, 157
— lyropetala, 157
Duabanga moluccana, 269
Dysoxylum **micranthum,** 257
— **Whiteanum,** 256
Elaeagnus triflora, 267
Eroteum, 459
— *albo-punctatum,* 399
— *hirsutum,* 479
— *subintegrifolium,* 476
— *theaeoides,* 413
— *undulatum,* 464
— *yungasium,* 487
Euonymus Maackii **lanceolata,** 578
Euphorbia astyla, 159
— Fendleri, 133
— — *dissimilis,* 133
— — *typica,* 133
Euphorbiaceae in eastern tropical Asia, The tribe Plukenetiinae of the, 417
Eurya § *Cleyera,* 397
— §*Freziera,* 459
— subgen. *Cleyera,* 397
— subgen. *Freziera,* 459
— *albo-punctata,* 399
— *angulosa,* 466
— *arbutifolia,* 480
— *Benthamiana,* 402
— *boliviensis,* 488
— *Bolleana,* 403
— *calophylla,* 474
— *candicans,* 492
— *canescens,* 491
— *cernua,* 404
— *conocarpa,* 496
— *cordata,* 462

Eurya Dombeyana, 487
— *Ekmani*, 401
— *ferruginea*, 479
— *Friedrichsthaliana*, 471
— *Grisebachii*, 479
— *guatemalensis*, 468
— *guianensis*, 490
— *Hintoni*, 189
— *Humboldtiana*, 481
— *inaequalifolia*, 470
— *inaequilatera*, 470
— *integrifolia*, 402
— *Karsteniana*, 484
— *lanata*, 487
— *lancifolia*, 478
— *Lehmannii*, 474
— *longipes*, 473
— *macrophylla*, 469
— *mexicana*, 402
— *monzonensis*, 496
— *nervosa*, 474
— *nimanimae*, 411
— *nitida*, 467
— *panamensis*, 412
— *reticulata*, 481
— — *subintegrifolia*, 482
— *roraimensis*, 490
— *Seemanniana*, 492
— *sericea*, 482
— — *chrysophylla*, 494
— *spathulifolia*, 472
— *suberosa*, 466
— *subintegrifolium*, 476
— *syphilitica*, 402
— *ternstroemioides*, 416
— *theoides*, 414
— *undulata*, 464
— *vaccinioides*, 415
— *verrucosa*, 475
— *Wawrai*, 483
— *yungasia*, 487
Evodia **asteridula**, 41
— Bonwickii, 39
— **cladantha**, 37
— *coriacea*, 45
— **crispula**, 35
— **cuneata**, 39
— Elleryana tetragona, 38
— **eriophylla**, 38
Evodia *lamprocarpa*, 41
— **oligantha**, 34
— **papuana**, 42
— Peekelii, 43
— **phanerophlebia**, 40
— **philippinensis**, 45
— Radlkoferiana, 41
— **rosea**, 36
— **silvatica**, 44
— **simulans**, 43
— **solomonensis**, 43
— trichopetala, 36
— vitiflora, 40
Fagara Rhetsa, 33
— *varians*, 32
Fendlera **rigida**, 112
Ficus *adenosperma*, 93
— androbrota, 90
— **Archboldiana**, 84
— arfakensis, 100
— Armiti, 92
— Baeuerleni, 103
— benjamina, 86
— Bernaysii, 99
— Bismarckiana, 95
— *brachiata*, 101
— Branderhorstii, 92
— calodictya, 102
— Caroli, 92
— *casearia*, 96
— chaetophora, 93
— charadrophila, 95
— *chrysochlamys*, 87
— cinnabarina, 102
— conora, 101
— *Decaisneana*, 89
— dichroa, 88
— distichoidea, 102
— duriuscula, 95
— **endochaete**, 94
— **formosa**, 97
— **fuscata**, 103
— garciniifolia, 86
— gibbosa, 90
— glabella, 87
— grandis, 99
— *grandis*, 99
— **gymnorygma**, 107
— Hahliana, 99

Ficus hololampra, 93
— hylobia, 89
— hylophila, 98
— hypophaea, 106
— hystricicarpa, 92
— ihuensis, 107
— incompta, 107
— *infectoria,* 87
— **insculpta,** 105
— **irritans,** 104
— lacor, 87
— leptodictya, 90
— *longepedunculata,* 96
— macrorrhyncha, 91
— **mafuluensis,** 83
— mangiferifolia, 88
— microdictya, 106
— muriculata, 96
— myriocarpa, 101
— **myrmekiocarpa,** 82
— nodosa, 101
— ochrochlora, 90
— Odoardi, 106
— pachythyrsa, 100
— Pantoniana, 102
— patellifera, 88
— phaeosyce, 92
— philippinensis, 89
— pilosa, 87
— *pteleiphylla,* 91
— pyconeura, 93
— regnans, 85
— retusa, 86
— rhizophoriphylla, 85
— sclerotiara, 81
— Scratchleyana, 107
— septica, 96
— setistyla, 99
— spec., 88, 107
— sterrocarpa, 81
— stipulosa, 87
— subulata, 89
— trachypison, 91
— trichosphaeridia, 104
— variegata, 102
— xanthosyce, 95
Flacourtiaceae (Pangieae-Hydnocarpinae) from tropical Queensland, A new genus of, 143
Flaveria anomala, 165
Flindersia **chrysantha,** 59
— Schottiana, 58
Fouquieria Shrevei, 160
Frankenia gypsophila, 160
Freziera, Studies in the Theaceae, VIII. A synopsis of the genus, 457
Freziera, 459
— angulosa, 466
— arbutifolia, 480
— *boliviensis,* 487
— *Bolleana,* 403
— Bonplandiana, 495
— **caloneura,** 477
— calophylla, 474
— candicans, 492
— canescens, 490
— — **rufescens,** 492
— *cernua,* 404
— chrysophylla, 494
— conocarpa, 496
— cordata, 462
— *Dombeyana,* 486
— *Ekmani,* 401
— *elegans,* 465
— **euryoides,** 486
— ferruginea, 479
— Friedrichsthaliana, 471
— Grisebachii, 479
— guatemalensis, 468
— *guianensis,* 490
— Hieronymi, 467
— hirsuta, 463
— *hirsuta,* 479
— *ilicioides,* 411
— *inaequalifolia,* 471
— inaequilatera, 470
— *integrifolia,* 401
— Karsteniana, 484
— lanata, 487
— lancifolia, 478
— *Lehmannii,* 474
— longipes, 473
— macrophylla, 469
— *mexicana,* 402
— monzonensis, 496
— nervosa, 474
— *nimanimae,* 411
— **parva,** 485

Freziera *Perrottetiana*, 464
— reticulata, 481
— — subintegrifolia, 482
— roraimensis, 490
— *salicifolia*, 464, 483
— — *undulata*, 464
— *Seemanniana*, 492
— sericea, 482
— — *chrysophylla*, 494
— *sericea*, 492
— **Smithiana**, 470
— spathulifolia, 472
— suberosa, 466
— subintegrifolia, 476
— *ternstroemioides*, 416
— *theoides*, 413
— **tomentosa**, 486
— undulata, 460, 464
— — elegans, 465
— — *hirsuta*, 463
— *vaccinioides*, 415
— verrucosa, 475
— Wawrai, 483
— *yungasia*, 487
Gaillardia multiceps, 166
Garcinia **angustifolia**, 355
— **Archboldiana**, 366
— **balimensis**, 360
— *Branderhorstii*, 361
— **Engleriana**, 367
— Hunsteinii, 365
— **idenburgensis**, 368
— *latissima*, 370
— **Lauterbachiana**, 361
— **macrantha**, 359
— *novo-guineensis*, 354
— **pachyantha**, 355
— **platyphylla**, 369
— **rhynchophylla**, 362
— **riparia**, 356
— Schraderi, 365
— **solomonensis**, 357
— subtilinervis, 363
— **Warburgiana**, 354
— Warrenii, 361
Genistidium, 113
— **dumosum**, 113
Gypsophily among Mexican desert plants, 145
Gyrinops Ledermannii, 264
Haploesthes Greggii, 168
— — **multiflora**, 170
— — **texana**, 169
— **robusta**, 121
Hedycarya solomonensis, 231
Hemistemma Banksii, 497
Henslovia Cumingii, 270
Hibbertia Banksii, 497
Hicoria Pecan, 571
Hicorius pecan, 571
Hippocrateaceae from New Guinea, Brassiantha, a new genus of, 389
Horsfieldia **congestiflora**, 64
— Hellwigii, 61
— novo-guineensis, 62
— **pachycarpa**, 64
— **solomonensis**, 63
— **trifida**, 60
— tuberculata, 62
HOWARD, R. A. & I. W. BAILEY. The comparative morphology of the Icacinaceae, I, Anatomy of the node and internode, 125
— The comparative morphology of the Icacinaceae II, Vessels, 171
— The comparative morphology of the Icacinaceae III, Imperforate tracheary elements and xylem parenchyma, 432
— The comparative morphology of the Icacinaceae IV. Rays of the secondary xylem, 556
Hypericum **habbemense**, 343
Icacinaceae, I, Anatomy of the node and internode, The comparative morphology of the, 125
Icacinaceae II, Vessels, The comparative morphology of the, 171
Icacinaceae III, Imperforate tracheary elements and xylem parenchyma, The comparative morphology of the, 432
Icacinaceae IV, Rays of the secondary xylem, The comparative morphology of the, 556
Idenburgia elaeocarpoides, 233
— **pauciflora**, 234
Ilex **scabridula**, 258
— **Versteeghii**, 259

Imperforate tracheary elements and xylem parenchyma, The comparative morphology of the Icacinaceae III, 432
Isomerocarpa, 250
— **novoguineensis,** 251
Isotrema chrysops, 574
JOHNSTON, IVAN M. Gypsophily among Mexican desert plants, 145
— New phanerogams from Mexico, IV, 110
Juglans alba pacana, 571
— *angustifolia,* 571
— *cylindrica,* 571
— *illinoinensis,* 571
— *olivaeformis,* 571
— *pecan,* 571
Kelleria **patula,** 267
Kibara **Archboldiana,** 240
— **elongata,** 244
— inamoena, 241
— **laurifolia,** 240
— **papuana,** 242
— **rigidifolia,** 243
KOBUSKI, CLARENCE E. Studies in the Theaceae, VI, The genus Symplococarpon Airy-Shaw, 188
— Studies in the Theaceae, VII, The American species of the genus Cleyera, 395
— Studies in the Theaceae, VIII. A synopsis of the genus Freziera, 457
Lagerstroemia Archeriana, 268
Lauraceae, III, Some critical and new species of Asiatic Lindera, with occasional notes on Litsea, Studies in the, 1
Laurus Nacusua, 9
Ledebour's "Flora Rossica," "Icones plantarum novarum," and "Flora Altaica," with a note on Pallas' "Flora Rossica," 225
Leea indica, 380
— macropus, 382
— **papuana,** 382
— *sambucina,* 380
— **solomonensis,** 380
— suaveolens, 381
Lettsomia, 459
— *candicans,* 492
Lettsomia Dombeyana, 486
— *lanata,* 487
— *longipes,* 473
— *tomentosa,* 486
Leucophyllum **candidum,** 120
— **griseum,** 119
— **pruinosum,** 119
Levieria nitens, 232
— **parvifolia,** 233
— squarrosa, 232
Lindera, with occasional notes on Litsea, Studies in the Lauraceae, III, Some critical and new species of Asiatic, 1
Lindera *alongensis,* 30
— angustifolia, 8
— assamica, 1
— *Bodinieri,* 8
— caudata, 28
— *caudata,* 23
— Chunii, 29
— communis, 8
— — grandifolia, 9
— **dictyophylla,** 5
— **Doniana,** 10
— Duclouxii, 12
— Eberhardtii, 30
— erythrocarpa, 15
— **flavinervia,** 30
— **Gambleana,** 27
— — **floribunda,** 28
— glauca, 8
— — *nitidula,* 9
— **Hemsleyana,** 25
— — **velutina,** 25
— *hypoglauca,* 15
— **kwangtungensis,** 2
— — **robusta,** 3
— latifolia, 7
— Laureola, 9
— **longipedunculata,** 6
— Meissneri, 2
— — *kwangtungensis,* 2
— — lenticellata, 2
— *membranacea,* 13
— **Metcalfiana,** 3
— Nacusua, 9
— *Paxiana,* 9
— pedunculata, 11

Lindera Playfairii, 29
— pulcherrima, 20
— — **attenuata,** 21
— — glauca, 21
— *pulcherrima,* 22
— reflexa, 17
— rufa, 29
— sericea, 16
— — glabrata, 17
— **Stewardiana,** 26
— spec., 12
— **sterrophylla,** 12
— strychnifolia, 28
— — *Hemsleyana,* 25
— — *var.,* 25
— — *velutina,* 25
— subcaudata, 23
— supracostata, 24
— — **attenuata,** 24
— **Thomsonii,** 22
— tonkinensis, 20
— umbellata, 13
— — hypoglauca, 14
— — *latifolia,* 17
— — pubescens, 15
— — *sericea,* 16
— **urophylla,** 23
— **Vernayana,** 24
— *yunnanensis,* 8
Litsea, Studies in the Lauraceae, III, Some critical and new species of Asiatic Lindera, with occasional notes on, 1
Litsea **Merrilliana,** 11
— *Playfairii,* 29
— **szechuanica,** 18
Lobelia *affinis,* 386
— *barbata,* 386
— **brachyantha,** 385
— Gaudichaudii, 135
— — *coccinea,* 135
— — *typica,* 135
— microcarpa, 385
— *succulenta,* 386
— zeylanica, 386
Loeselia Havardii, 160
Lonicera **codonantha,** 578
— Myrtillus **cyclophylla,** 579
Mallotus, New species of, 204
Mallotus *apelta,* 204
— — **kwangsiensis,** 204
— *barbatus congestus,* 206
— **Croizatianus,** 204
— **Dunnii,** 205
— **lotingensis,** 206
— **luchenensis,** 206
— philippensis **reticulatus,** 207
— *reticulatus,* 207
— *Roxburghianus glabra,* 205
— spec., 204
Mangifera **inocarpoides,** 532
— minor, 532
Megistostigma cordatum, 426
— malaccense, 425
— peltatum, 426
— **yunnanense,** 426
Melicope **clathrata,** 49
— **coriacea,** 49
— **heterophylla,** 48
— **macrophylla,** 51
— **mucronata,** 50
— novo-guineensis, 48
— **parvifolia,** 45
— **perspicuinervia,** 50
— **polyadenia,** 47
— **pubifolia,** 53
— **solomonensis,** 52
— **sterrophylla,** 46
Meliosma **Schlechteri,** 262
MERRILL, E. D. A note on the dates of issue of the fascicles comprising Cosson's "Illustrationes Florae Atlanticae" 1882–1897, 455
— A note on the dates of publication of Wight's "Icones plantarum Indiae Orientalis," 222
MERRILL, E. D. & L. M. PERRY. Observations on old world species of Turpinia Ventenat, 543
— Plantae Papuanae Archboldianae, 32, 253, 375, 529
METCALF, FRANKLIN P. New species of Mallotus, 204
Momordica Grosvenori sp. nov., The source of the Chinese lo han kuo, 197
Muhlenbergia villiflora, 155

Muñoz, Carlos. Relchela panicoides Steudel, Gramineae endemica en Chile, 209
Murrill, William A. & Ernest J. Palmer. A new willow from Florida, 580
Myristica **Archboldiana,** 73
— **Brassii,** 72
— **cerifera,** 77
— **Clemensii,** 78
— *faroensis,* 74
— fusca, 67
— Hollrungii, 67
— inutilis, 74
— **Kajewskii,** 68
— **Markgraviana,** 66
— **multinervia,** 70
— **pachyphylla,** 69
— **petiolata,** 69
— **platyphylla,** 76
— **procera,** 79
— salomonensis, 75
— Schleinitzii, 74
— **sphaerosperma,** 71
Nama canescens, 162
— carnosum, 163
— hispidum **gypsicola,** 162
— Purpusii, 161
— serpylloides velutina, 162
— **Stewartii,** 114, 161
Neolitsea Playfairii, 29
— *subcaudata,* 23
Nerisyrenia Castillonii, 158
— **gracilis,** 157
— incana, 159
— linearifolia, 158
Netherlands New Guinea, The 1938–39 Expedition to the Snow Mountains, 271, 297
New genus of Flacourtiaceae (Pangieae-Hydnocarpinae) from tropical Queensland, A, 143
New Guinea, Additions to our knowledge of the figs of, 81
New Guinea, Brassiantha, a new genus of Hippocrateaceae from, 389
New phanerogams from Mexico, IV, 110
New Species of Mallotus, 204
New species, varieties and combinations from the collections of the Arnold Arboretum, 569
New willow from Florida, A, 579
Nichols, Charles, Jr. & E. Chalmers Smith. Species hybrids in forest trees, 443
Note on the dates of issue of the fascicles comprising Cosson's "Illustrationes Florae Atlanticae" 1882–1897, A, 455
Note on the dates of publication of Wight's "Icones plantarum Indiae Orientalis," A, 222
Notholaena bryopoda, 154
Observations on old world species of Turpinia Ventenat, 543
Palmer, Ernest J. & William A. Murrill. A new willow from Florida, 580
Palmeria arfakiana, 245
— Fengeriana, 248
— **habbemensis,** 246
— **incana,** 245
— **montana,** 247
— **puberula,** 249
Panicum oligostachium, 213
Papuasian Plants, Studies of, 60, 231, 343, 497
Parasponia **rigida,** 254
— **simulans,** 255
Parastemon Versteeghii, 256
Pentaphalangium **Brassii,** 372
— latissimum, 370
— **pachycarpum,** 371
— **solomonense,** 373
Pentaphragma macrophyllum, 384
Perityle **Castillonii,** 122
Perrottetia **traumatophylla,** 261
Perry, L. M. and E. D. Merrill. Observations on old world species of Turpinia Ventenat, 543
— Plantae Papuanae Archboldianae, 32, 253, 375, 529
Petalonyx crenatus, 160
Petrogenia, 116
— **repens,** 116
Phacelia **gypsogenia,** 163

Phaleria Perrottetiana, 265
— **subcaudata,** 265
Phyllocharis **subcordata,** 387
Plantae Papuanae Archboldianae, 32, 253, 375, 529
Plukenetia corniculata, 425
Plukenetiinae of the Euphorbiaceae in eastern tropical Asia, The tribe, 417
Podocarpus coraianus, 570
— *koraiana,* 570
Prinsepia uniflora **serrata,** 575
Pterococcus corniculatus, 425
— *glaberrimus,* 425
Quercus *dilatata,* 572
— floribunda, 572
— *floribunda,* 572
— petraea **insecata,** 573
— — *laciniata,* 573
— *sessiliflora insecata,* 573
— — *laciniata,* 573
— *sessilis laciniata,* 573
Ramelia codonostylis, 431
REHDER, ALFRED. New species, varieties and combinations from the collections of the Arnold Arboretum, 569
Relchela panicoides Steudel, Gramineae endemica en Chile, 209
Rhus *Engleriana,* 536
— *panaciformis,* 536
— *retusa,* 536
— — *rufa,* 536
— *rufa,* 536
— taitensis, 536
Robinia chamlagu, 576
— *chinensis,* 576
— *lucida,* 576
— *sinica,* 576
Rotala mexicana, 268
Sakakia, 397
Salix **astatulana,** 580
Salvia texana canescens, 118
Salviastrum **canescens,** 118
— *texanum canescens,* 118
Sanicula canadensis *genuina,* 134
— — grandis, 135
— — typica, 134
— — *typica,* 135
Sartwellia Flaveriae, 168
Sartwellia **humilis,** 167
— mexicana, 167
— puberula, 167
Saurauia **albiflora,** 506
— **alpicola,** 516
— **arcana,** 518
— **Archboldiana,** 514
— **belensis,** 505
— Brassii, 512
— calyptrata, 503
— **capitulata,** 521
— **collina,** 513
— conferta, 524
— **congestiflora,** 519
— **Dielsiana,** 510
— **eburnea,** 520
— **excurrens,** 503
— *eximia,* 503
— **fimbriata,** 508
— holotricha, 510
— **idenburgensis,** 513
— **Kajewskii,** 511
— **macrantha,** 507
— **occulta,** 523
— pleurotricha, 521
— *rosea,* 509
— **rubrisquamata,** 504
— Schumanniana, 509
— sterrolepida, 515
— **tafana,** 517
Schuurmansia *Bamleri longifolia,* 524
— **coriacea,** 525
— **grandiflora,** 527
— longifolia, 524
— **montana,** 526
Selinocarpus Purpusianus, 156
Semecarpus **Archboldiana,** 541
— **brachystachys,** 540
— **decipiens,** 539
— fulvo-villosa, 538
— magnifica, 537
— rostrata, 538
SMITH, A. C. Studies of Papuasian Plants, 60, 231, 343, 497
— & I. W. BAILEY. Brassiantha, a new genus of Hippocrateaceae from New Guinea, 389
SMITH, E. CHALMERS. Chromosome behavior in Catalpa hybrida Spaeth, 219

SMITH, E. CHALMERS & CHARLES NICHOLS, JR. Species hybrids in forest trees, 443
Snow Mountains, Netherlands New Guinea, The 1938–39 Expedition to the, 271, 297
Solidago nemoralis *decemflora*, 136
— — longipetiolata, 136
Sonneratia ovata, 269
Species hybrids in forest trees, 443
Sphaerostylis **anomala**, 430
— **Frieseana**, 430
— *glabrata*, 425
— *malaccensis*, 425
— **natalensis**, 430
Sporobolus Nealleyi, 155
Staphylea indica, 380
STEARN, WILLIAM T. Ledebour's "Flora Rossica," "Icones Plantarum novarum," and "Flora Altaica," with a note on Pallas' "Flora Rossica," 225
Steganthera **elliptica**, 236
— **ilicifolia**, 235
— insignis, 237
— Schumanniana, 235
Studies in the Lauraceae, III, Some critical and new species of Asiatic Lindera, with occasional notes on Litsea, 1
Studies in the Theaceae, VI, The genus Symplococarpon Airy-Shaw, 188
Studies in the Theaceae, VII, The American species of the genus Cleyera, 395
Studies in the Theaceae, VIII, A synopsis of the genus Freziera, 457
Studies of Papuasian Plants, 60, 231, 343, 497
SUMMERHAYES, V. S. Additions to our knowledge of the figs of New Guinea, 81
SWINGLE, WALTER T. Momordica Grosvenori sp. nov., The source of the Chinese lo han kuo, 197
Symplococarpon Airy-Shaw, Studies in the Theaceae, VI, The genus, 188
Symplococarpon, 188
— **Airy-Shawianum**, 190
— **Brenesii**, 194
— **chiriquiense**, 192
— Hintoni, 189
Symplococarpon *Hintoni*, 190
— **multiflorum**, 193
— **Purpusii**, 191
Taxus Harringtonia, 569
— *Inukaja*, 569
— *Sinensis*, 569
Terminthodia, 53
— *lanceolata*, 54
— *obovata*, 55
— *oppositifolia*, 54
— *orbiculata*, 54
— *rotundifolia*, 54
— *Schultzei Leonhardi*, 54
— *Treubiana*, 54
Ternstroemia albo-punctata, 399
— *Purpusii*, 191
— *serrulata*, 407
— *syphilitica*, 401
Tetractomia, 53
— **lanceolata**, 54
— **Lauterbachiana**, 55
— — **pumila**, 55
— **oppositifolia**, 54
— **orbiculata**, 54
— **rotundifolia**, 54
— **Schultzei Leonhardi**, 54
— **Treubiana**, 54
Tetranthera bifaria, 9
— *pulcherrima*, 20
Tetrastigma Lauterbachianum, 376
— Pullei, 375
Theaceae, VI, The genus Symplococarpon Airy-Shaw, Studies in the, 188
Theaceae, VII, The American species of the genus Cleyera, Studies in the, 395
Theaceae, VIII, A synopsis of the genus Freziera, Studies in the, 457
Thelesperma ramosius, 165
— scabridulum, 165
Tragia *anisosepala*, 429
— *anomala*, 430
— Delpyana, 425
— *Frieseana*, 430
— *involucrata*, 429
— *natalensis*, 430
Tragiella anomala, 430
— *Frieseana*, 430
— *natalensis*, 430
Triceros cochinchinensis, 551

Tristylium, 397
— ***mexicanum***, 402
Turpinia Ventenat, Observations on old world species of, 543
Turpinia **affinis**, 550
— cochinchinensis, 551
— glaberrima, 552
— — **stenophylla**, 552
— ***gracilis***, 553
— latifolia, 548
— — **pubescens**, 548
— laxiflora, 553
— ***lucida***, 549
— malabarica, 547
— montana, 552
— — **borneensis**, 553
— ***nepalensis***, 551
— **nitida**, 549
— ovalifolia, 549
— ***pachyphylla***, 549
— **papuana**, 554
— ***parva***, 553
— pomifera, 546
— ***pomifera***, 547
— sambucifolia, 547
— sphaerocarpa, 547
— ternata, 550
Turpinia **Versteeghii**, 554
Velleia spathulata, 387
Ventilago **papuana**, 263
Vessels, The comparative morphology of the Icacinaceae II, 171
Vitis acetosa, 375
— ***assamica***, 377
— ***hypoglauca***, 378
— ***japonica***, 379
Wahlenbergia **confusa**, 383
— gracilis, 384
WHITE, C. T. A new genus of Flacourtiaceae (Pangieae-Hydnocarpinae) from tropical Queensland, 143
Wikstroemia **venosa**, 266
Wormia auriculata, 501
— **crenata**, 498
— **ingens**, 501
— **insignis**, 500
— macrophylla, 498
— **nitida**, 499
Xanthochymus novo-guineensis, 354
Zanthoxylum **conspersipunctatum**, 33
— dimorphophyllum **deminutum**, 577
— **Dominianum**, 32
— ***montanum***, 552
— Rhetsa, 33